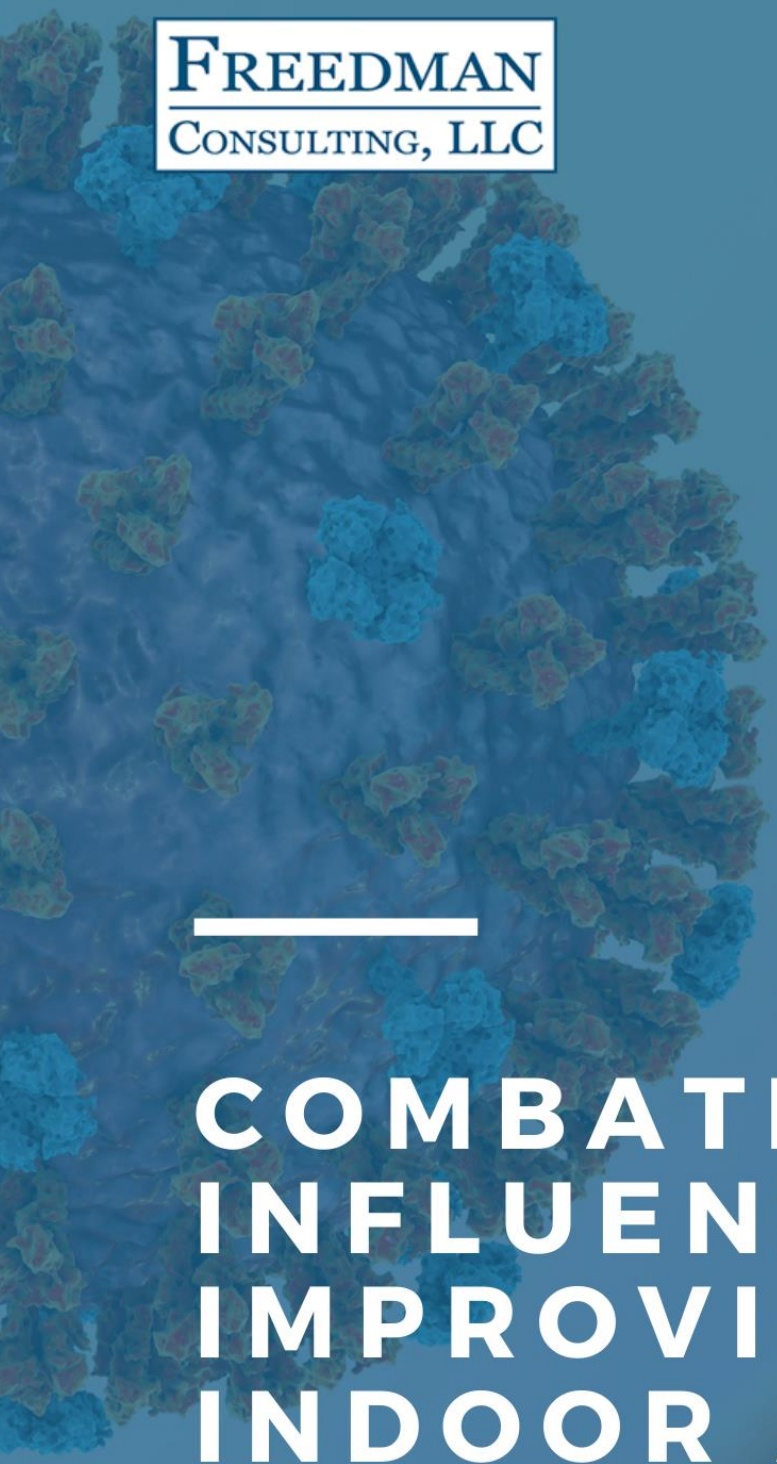
FREEDMAN CONSULTING, LLC

A REPORT FOR

FLU LAB

FEBRUARY 14, 2022



COMBATING INFLUENZA BY IMPROVING INDOOR AIR

Potential Interventions to Advance IAQ Improvements, and Possible Funder Roles

Introduction from Flu Lab

Flu Lab makes grants and investments to advance solutions to pressing influenza challenges. We welcome the increased recognition of the importance of improving indoor air quality as part of the COVID-19 pandemic response, spearheaded by aerosol experts from around the world. Although the relative contribution of aerosol transmission compared with droplet transmission remains a topic of debate among global and national public health authorities, organizations like the World Health Organization and the US Centers for Disease Control and Prevention have acknowledged that improved ventilation and air filtration measures indoors have the potential to reduce SARS-CoV-2 transmission. Flu Lab believes the same holds for influenza transmission, which carries with it similar dynamics and disagreement among public health authorities and researchers.

Additional, layered measures to reduce influenza disease burden are needed and we view this time as a window of opportunity to make our public spaces less permissive to transmission. With improved indoor air quality where many people gather for sustained periods of time, we can reduce the risk of airborne infectious disease transmission.

Our aim with this landscaping effort was to assess whether there are levers of action ready to advance implementation of new measures and which, if any, are primed for philanthropic support. Flu Lab asked Freedman Consulting to identify trends shaping this area, critical issues and priorities, and areas and opportunities that appear the most promising for impact.

We are pleased to make the results of their effort publicly available to benefit those with shared interests.

Casey Wright
CEO, Flu Lab

Julie Schafer
CTO, Flu Lab

FLU LAB

Table of Contents

Report Overview

The COVID-19 pandemic has made the world acutely aware of the dangers of airborne virus transmission, and the role that ventilation, filtration, and other indoor air quality (IAQ) solutions can play in reducing transmission risk, mitigating community spread, and saving lives. And the very solutions that can mitigate airborne COVID-19 spread and improve IAQ have the potential to deliver a host of other benefits – including the ability to reduce the spread of influenza. However, despite the science being well known in this regard, and the primary solutions widely available, to date relatively little focus has been paid by policymakers, building administrators, facility managers, and other decisionmakers to the issues, let alone toward making the type of investments necessary to improve IAQ at scale.

The public interest community engaged in IAQ work is also underdeveloped. Despite a well-developed research community focused on these issues, relatively few government actors, non-profits and civil society groups, national or local advocacy organizations, or philanthropic institutions are engaged in efforts to improve IAQ. The result is that we know the issues and we know the solutions, but we lack the infrastructure to help translate that knowledge into action.

This document offers an overview of the current field of work focused on expanding adoption of IAQ solutions, and what may be needed to help develop and advance this work going forward. Included are an analysis of key gaps and barriers holding back adoption of proven solutions, a menu of potential interventions that could help fill these gaps and strengthen field efforts, and a set of considerations for philanthropic funders potentially interested in supporting work in this field.

The document draws on research by Freedman Consulting, conducted from September of 2021 to February of 2022. This included an in-depth literature review and desk research, as well as expert interviews with a diverse set of field stakeholders with knowledge of the issues, the solutions, and the ecosystem of actors. Potential interventions were developed based on ideas and suggestions offered by interviewees, as well as those developed internally by Freedman staff.

The document includes the following sections:

This document was prepared by Freedman Consulting for Flu Lab. This document has not undergone formal peer review, though overarching findings were validated with key experts prior to circulation to ensure the report is representative of field views and prevailing sentiments.

Suggested citation:

> Freedman Consulting, LLC. "Combating Influenza by Improving Indoor Air: Potential Interventions to Advance IAQ Improvements, and Possible Funder Roles." February 14, 2022.

I. Ecosystem Overview: Current State and Perceived Gaps and Needs

The need for better IAQ to prevent transmission of airborne, aerosolized pathogens like influenza and COVID-19 is well known and clear. The COVID-19 pandemic has created new momentum and opportunities to expand adoption of ventilation, filtration, and air cleaning solutions. However, the field of actors engaged in IAQ work remains relatively underdeveloped, missing key capacities needed to fully take advantage of current opportunities. With public awareness at an all-time high and the public primed to care about the transmission of indoor pathogens, as well as new levers of funding from recovery and infrastructure funds and rising interest among policymakers, the current moment presents a unique opportunity for this field to develop more fully, fill gaps and build needed capacities, and activate toward action.

Needed Functions: Envisioning an Effective IAQ Ecosystem

Overview of Necessary Ecosystem Functions:

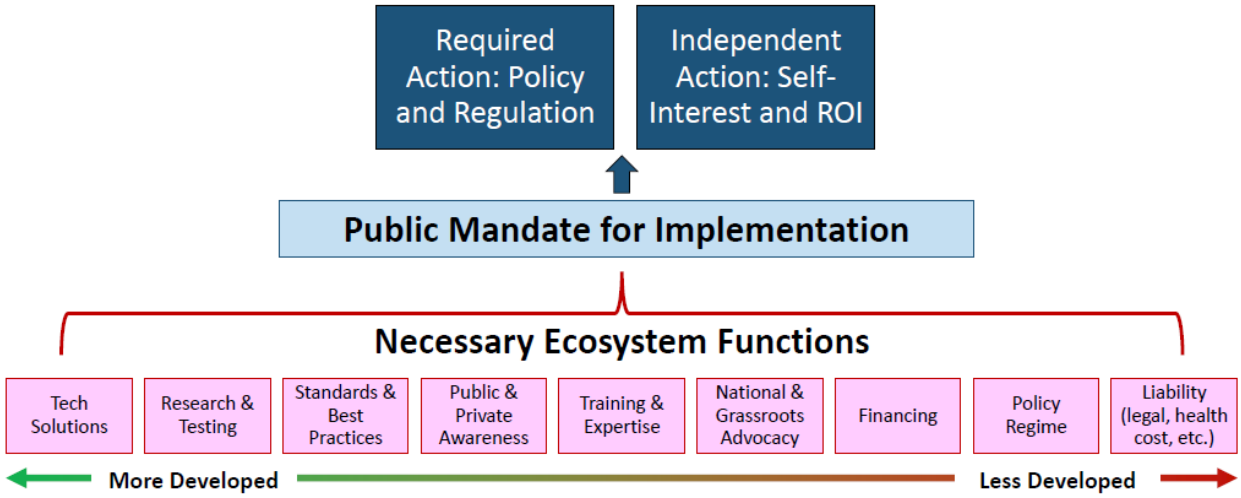


Figure 1: Overview of necessary ecosystem functions based on landscaping of IAQ space.

Broad adoption of proven IAQ solutions requires that the following elements are in place – ordered from those that are most well-supported by actors in the current ecosystem to those least-supported:

- **Tech Solutions:** Availability of safe, effective, and affordable technology solutions that can improve IAQ and reduce transmission of airborne infectious diseases.
- **Research & Testing:** Robust IAQ research ecosystem, including the capacity to support standardized testing and assessment of IAQ technologies and interventions.
- **Standards & Best Practices:** Available guidance on proven strategies for improving IAQ in different settings and informing actors looking to adopt and operate IAQ solutions.
- **Public & Private Awareness:** General public awareness of the importance of IAQ, and an understanding by private actors of what is needed to improve IAQ and reduce risks.
- **Training & Expertise:** Professional knowledge, skills, and expertise among facilities managers and building administrations on what solutions to implement and how to optimize operation.

- **National & Grassroots Advocacy:** Organizations at the national, state, and local levels advocating for improvements in IAQ, including via policy change and implementation action.
- **Financing:** Public and private funding available to support installation of IAQ solutions in priority settings.
- **Policy Regime:** Policy mandates and regulation regarding IAQ, including standard setting, oversight of relevant technologies, and public funding for installation of IAQ solutions.
- **Liability:** Legal liability risk for the adverse impacts of poor IAQ in private settings, such as financial liability for adverse health outcomes of workers, customers, or the general public.

Though all of these functions need further development, some are supported by current ecosystem actors with clear paths for growth and further gap filling, while others are not as yet not supported and will require addition of new actors and field capacities. This suggests that efforts to expand field impact can include both near-term opportunities to support existing work, as well as longer-term capacity building approaches.

Overview of Current IAQ Intervention Options:

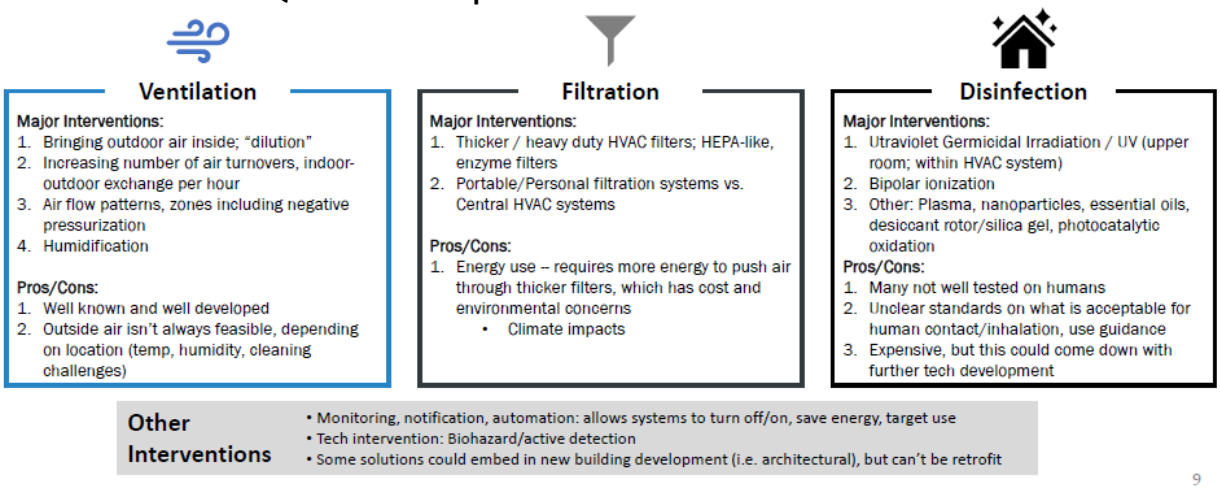


Figure 2: Catalogue of current IAQ intervention options categorized into the three primary intervention areas available.

Current State: Missing Intermediaries to Help Translate Knowledge into Action

A strength of the ecosystem as it exists today is that the challenges and general solutions are well known. The major IAQ solutions around ventilation, filtration, and air cleaning are reasonably well-developed, and the costs for these solutions have decreased significantly over time. There is a large academic focus on IAQ and disease transmission that is actively engaged in addressing continued research gaps.

However, the current ecosystem lacks infrastructure and key capacities needed to help translate the research base and technology solutions into real-world implementation. Regulation and policy on IAQ are essentially non-existent. The national and grassroots advocacy infrastructure needed to raise public awareness of IAQ, and to promote policy and implementation efforts on the ground, is nascent, with few organizations focused on this work and limited capacity for efforts at scale. There is also little or no philanthropic engagement and funding at present, despite intersectional interests that align with IAQ improvement needs, such as in public health, children's health and development, K-12 education, and other issue areas. The lack of needed ecosystem actors and key capacities presents a major barrier to achieving widespread adoption and change.

Overview of IAQ Ecosystem and Current & Future Stakeholders:

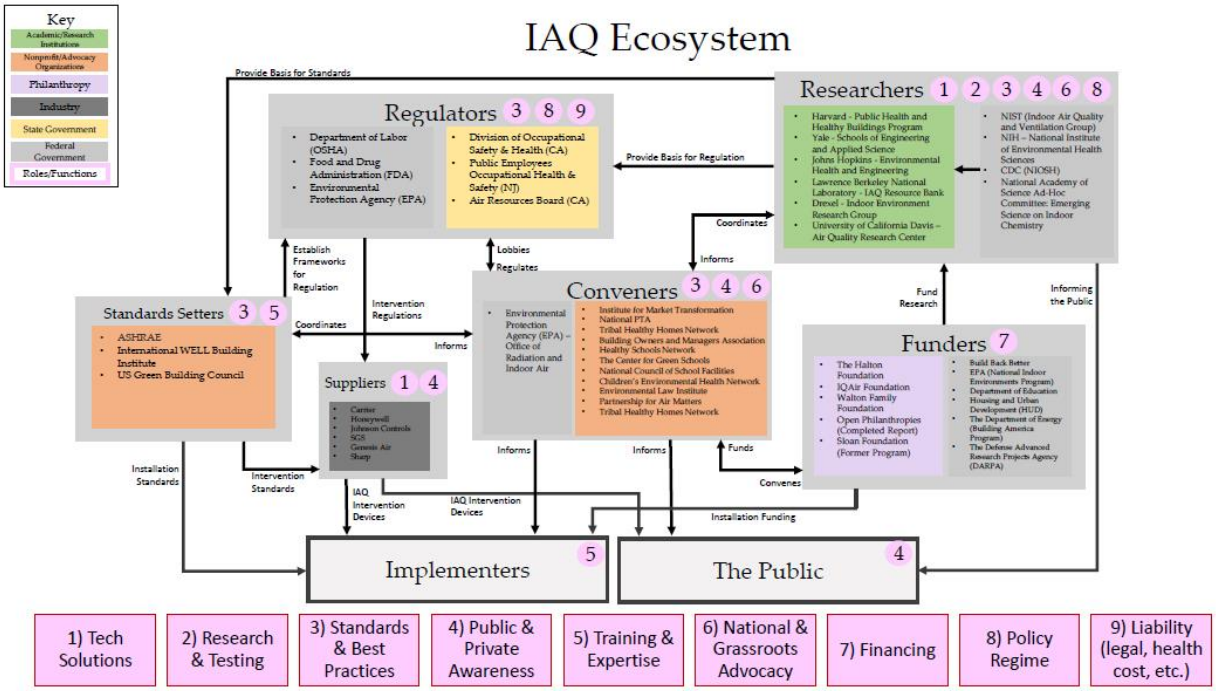


Figure 3: IAQ ecosystem map showing relational structure between key stakeholders. For a full-scale version, please see Appendix E

Promising Developments: Field Bright Spots and Models for Growth

While the field is critically underdeveloped, the ecosystem is growing, with more organizations and sectors engaging in IAQ than ever before in response to the current moment. The most promising ecosystem development centers around IAQ improvements in schools in the context of the COVID-19 pandemic, developing in response to public interest in reopening schools safely. While this work is still ad hoc and decentralized, the engagement of cross sector actors – including government, unions, school administrators, PTAs, and policy advocacy organizations alongside traditional IAQ stakeholders – presents a promising model for a more effective ecosystem for promoting adoption in a particular priority setting.

And while there is no singular investment or vehicle for innovative investment, several actors in the current ecosystem could be well positioned for increased roles as the field grows, evolves, and more public and private interest and attention is paid to IAQ issues. There are actors in the ecosystem that are focused on both near-term and long-term opportunities and needs for the field and are thinking strategically about what is needed to grow the IAQ field.

II. Potential Interventions to Advance IAQ Improvements

Considering the nascent nature of the current IAQ field, the gaps and needs outlined above are numerous and diverse, leading to a large and varied set of potential interventions that can advance field efforts and goals. This section of the report provides a brief overview of four main categories of potential interventions which could help drive broader adoption of indoor air quality solutions, as well as a snapshot value assessment of these interventions for comparison purposes. The Appendix of this document includes a more detailed overview of each category, as well as outlines for each specific intervention with an overview of the need, potential approaches, and value analysis.

Importantly, many of the interventions outlined herein are theorized approaches, rather than specific grantmaking opportunities. To translate these interventions into concrete actions will require further investigation, development, and planning with field stakeholders and potential partners.

Potential needed interventions include:

Support for Adoption of IAQ Solutions During COVID-19

These interventions focus on advancing adoption of proven IAQ solutions in priority settings, with goals of realizing direct public health improvements and leveraging findings from pilots and other techniques to support long-term scaling of IAQ solutions.

Direct Deployment of IAQ Solutions

- ***Financing IAQ Investments:*** Working with partners to identify underserved high-risk settings where IAQ investments have great potential to realize public health benefits, and for which philanthropic investment would have a major catalyzing effect. Financing models could include direct provision, open grant funding, or experimenting with performance contracts.

- ***Potential Pilot Design:*** Regardless of financing approach, supporting installation of IAQ solutions could be developed as a pilot approach, in partnership with researchers and providers, such as a quasi-experimental comparative analysis of different IAQ solutions in real-world settings.

Building Public Awareness

- ***Public Awareness Campaigns to Drive Call for Action:*** Using the current pandemic to build cultural and scientific momentum towards widespread IAQ intervention adoption will require increased public awareness of IAQ and infectious disease-related issues. A public awareness campaign informing people about IAQ solutions would be a powerful tool to drive action.

IAQ Best Practices and Policy Development

These interventions focus on translating information and resources about IAQ issues and solutions into actionable knowledge and expertise among key actors, with goals of bolstering on-the-ground implementation efforts and informing policy change.

Best Practices Collection and Dissemination

- ***Facilities Managers Trainings:*** Facilities managers do not currently receive any continuing education on new practices for their profession. Providing professionalization of this role and designing trainings on how to best use new IAQ solutions would create safer buildings and reduce disease transmission.

- ***Platform for Best Practices for Procurement Officers:*** Procurement officers are often responsible for decisions on how governments at all levels invest their budgets for IAQ improvements. In a market that is mostly unregulated, informing these decisionmakers of the most trustworthy and effective solutions to invest in can help focus the market on proven solutions.

Research and Policy Development

- ***Think Tank Program on IAQ Policy:*** One major gap is the lack of connection between the academic research on IAQ and policymakers understanding its implications for their decision making. A think tank program is a key part of that connective tissue to develop.

- ***Study Use of Federal Funding for IAQ Solutions During COVID-19:*** **Current** funding from federal stimulus bills, and some programs will include investments in improving indoor air quality in public spaces. Evaluating the effectiveness of these investments and identifying lessons can help improve subsequent public investment.

- ***Support State-Level IAQ Policymaking:*** States can provide excellent policy experiments to inform federal action, and changes to IAQ policy are already being considered in states across the country to respond to the COVID-19 pandemic. Supporting the passage of these experiments could be informative for future policymaking.

- ***Advancing Global IAQ Policy Dialogue:*** Aerosol viruses is not a challenge unique to any one nation, and every country can benefit from learning best practices on IAQ policy. A global conversation about potential regulations can lead to global impacts.

Field Building and Campaign Development

These interventions are centered on building, with a goal of broadening the set of stakeholders involved in supporting and advocating for adoption of IAQ solutions.

Field Growth and Development

- ***Field Strategic Planning and Coordination:*** Initiative to mature the IAQ ecosystem by conducting field strategic planning and coordination amongst stakeholders through cohesive ecosystem mapping and/or convening of stakeholders.

- ***Engagement with Potential Allied Funding Organizations:*** Targeted efforts to bring potentially allied funders further into IAQ related work, including early-stage informal outreach, and potential development of a forum for philanthropic coordination in the medium or long-term.

Engaging New Stakeholders

- ***Collaborate with Plaintiff Lawyers for IAQ Liability:*** Proactive engagement with plaintiff lawyer community to support development of legal precedents and hard law regarding liability for adverse outcomes due to poor IAQ, to create incentives for IAQ investment.

- ***Support Prominence of the Healthy Buildings Movement:*** Working with existing standard setting organizations to align on incorporation of IAQ standards into green building standards and further building the healthy buildings movement in a similar model.

Research Efforts to Fill Key IAQ Knowledge Gaps

These interventions are aimed at closing key remaining IAQ knowledge and research gaps, with the goals of removing barriers that stand in the way of broader adoption and improving understanding of how to further maximize effectiveness of IAQ solutions.

IAQ Effectiveness

- ***Studies to Develop ROI Proof Points:*** Funding studies to identify ROI Proof Points on IAQ solutions for consumers. Potential approaches include ROI for Different Settings, Comparison Across Products, Infectious Disease Impacts, and Health Cost Modeling.

- ***Real-World Studies on IAQ Intervention Effectiveness:*** Investing in research that tests IAQ solutions for real-world efficacy.

Testing and Standards Development

- ***Developing Recommended IAQ Standards:*** Producing recommended standards within the IAQ research and scientific communities.

- ***Industry-Wide Testing Standards:*** Aiding in the development of agreed upon standards within the IAQ development industry.

- ***Research to Support Development of IAQ Technologies:*** Filling the IAQ technological research gap by funding research to design and develop technologies such as safe UV and viral monitoring and rapid identification devices.

Assessing Potential Interventions: Key Factors and Considerations

Given the broad and varied nature of these different types of potential interventions, the value any individual approach might offer can also be quite distinct. To help provide insight into weighing the different types of value these interventions might offer, this report provides an initial assessment of each intervention across five key criteria:

1. **Long-term Strategic Value:** Considering the impact of the intervention towards the long-term strategic goals creating an ecosystem that can support and enable broad adoption of IAQ solutions in public spaces, in ways that can help reduce the spread of infectious diseases, including flu. Considering the impact of the intervention towards the long-term strategy, the overarching future goal, the state of the IAQ field, and the philanthropic partner's position and brand.

2. **Real-World Impact:** The potential for real-world impact particularly as it relates to public health outcomes, including weighing near-term vs long-term, applying an equity lens, and considering positive externalities (Flu/COVID/Asthma/etc.).

3. **Stakeholder Buy-In:** The level of interest and buy-in from funding partners, execution partners, and/or government partners.

4. **Ease of Execution:** Evaluation based on current barriers to execution, including cost, research gaps, and natural delaying factors.

5. **"Now or Never" Factor:** Considering factors uniquely applicable during the current COVID-19 pandemic, such as: available/expiring funding, temporary partners, public awareness, and the regulatory sandbox.

None of these criteria are mutually exclusive, and how to weight different types of value may be different for different actors or investors based on priorities, strategic foci, organizational ethos, or other factors.

Interventions Summary Table (See Appendix for Intervention Details)

To better establish how each intervention performs against these five criteria, this report provides a rough scoring of each intervention against each of these criteria on a 1 (lowest value) to 5 (highest value) scale. While this is not meant to be a scientific assessment, it helps to provide a snapshot comparison among the available interventions, and to summarize the more in-depth qualitative assessment provided in the Appendix. Additionally, while each of these scores have been aggregated to create an overall rating out of 25 points for additional summary, this raw score is inherently limited in that it assumes an equal weighting across criteria, and should be taken with this caveat.

	Long-Term Strategic Value	Real-World Impact	Stakeholder Buy-In	Ease of Execution	"Now or Never" Factor	Overall Rating
A. Support for Adoption of IAQ Solutions During COVID-19						
Financing IAQ Investments	1/5	3/5	4/5	3/5	5/5	**16/25: 64%**
Potential Pilot Design	5/5	5/5	1/5	2/5	4/5	**17/25: 68%**
Public Awareness Campaign on IAQ Issues and Solutions	3/5	2/5	2/5	3/5	4/5	**14/25: 56%**
B. IAQ Best Practices and Policy Development						
Facilities Managers Trainings	2/5	4/5	3/5	3/5	2/5	**12/25: 48%**
Platform for Best Practices for Procurement Officers	5/5	4/5	2/5	3/5	5/5	**19/25: 76%**
Think Tank Program for IAQ Policy	5/5	3/5	1/5	2/5	3/5	**14/25: 56%**
Study Use of Federal Funding for IAQ Solutions for COVID-19	4/5	3/5	3/5	4/5	5/5	**19/25: 76%**
Support State-Level IAQ Policymaking	4/5	4/5	3/5	2/5	5/5	**18/25: 72%**
Advancing Global IAQ Policy Dialogue	4/5	2/5	2/5	2/5	3/5	**13/25: 52%**
C. Field Building and Stakeholder Engagement						
Field Strategic Planning and Coordination	5/5	3/5	4/5	2/5	4/5	**18/25: 72%**
Engagement with Potential Allied Funding Organizations	4/5	2/5	1/5	2/5	4/5	**13/25: 52%**
Collaborate with Plaintiff Lawyers for IAQ Liability	4/5	4/5	2/5	1/5	5/5	**16/25: 64%**
Support Prominence of the Healthy Buildings Movement	3/5	3/5	2/5	2/5	2/5	**12/25: 48%**
D. Research Efforts to Fill Key IAQ Knowledge Gaps						
Studies to Develop ROI Proof Points	4/5	2/5	4/5	3/5	4/5	**17/25: 68%**
Real-World Studies on IAQ Intervention Effectiveness	4/5	2/5	3/5	2/5	4/5	**15/25: 60%**
Develop Recommended IAQ Standards	4/5	3/5	3/5	3/5	4/5	**17/25: 68%**
Industry-Wide Testing Standards	4/5	3/5	2/5	2/5	4/5	**15/25: 60%**
Research to Support Development of IAQ Techniques	4/5	3/5	4/5	2/5	3/5	**16/25: 64%**

III. Considerations for Philanthropic Approach

While the rating system offered in the previous section is rough and intended to allow the reader to compare the relative strengths and weaknesses of different interventions, it also displays a few important overarching themes: Several potential options across different intervention areas all score highly, and there is great variety in the type of value that any individual intervention offers. This shows that many approaches and opportunities are potentially attractive and offer the possibility for impact from different angles and on different time horizons.

Given the broad set of needs in an underdeveloped field, near- and medium-term investments must be looked at as opportunities to lay groundwork, achieve early wins, and set the preconditions necessary to support field growth and maturity over time. Importantly, the COVID-19 moment presents opportunities not just for real-world impact in the near-term, but also the potential to help put the ecosystem of actors engaged in IAQ work on a path to larger impact over the long-term. Philanthropic organizations interested in potentially supporting strategies to improve IAQ in public spaces should therefore consider a balance between near- and long-term approaches and goals – those that can best capitalize on the opportunities and momentum of the current moment, while also supporting field development needs that can support broader impact in the future.

Leveraging the Current Moment: Opportunities for Impact During COVID-19

Key potential foci for investments during the COVID-19 pandemic include: (1) Helping to expand existing nascent efforts to advance implementation (i.e. IAQ in schools) to both build field capacity and realize impact; (2) Taking advantage where possible of current interest among policymakers and the public to support near-term change and to prime these audiences for future change; and (3) taking advantage of unique COVID-related opportunities to fill critical research gaps.

For instance, several specific types of opportunities may be available in the near-term given the current state of play, which could align well with different packages of the interventions suggested in this document:

- **Policy:** State and local policymakers and some federal (WH/OSTP) stakeholders are interested in IAQ solutions, particularly in schools. Some groups are already plugged into that discussion, creating the opportunity for more robust engagement with additional capacity, focus, and near-term campaign planning among engaged organizations.

- **Implementation:** Some groups are already helping schools adopt best practices and invest in the right solutions. Demand for this work is high, particularly given high profile issues with adoption of unproven technologies. This work could be made more robust, with a particular focus on helping access infrastructure and remaining recovery funds.

- **Research:** While many of the known research gaps will take a long time to address, some targeted research efforts could yield benefits even in the near-term, particularly if focusing on research that will inform current actors interested in adopting IAQ solutions during the current pandemic. Additionally, many research gaps can *only* be filled through study of real-world implementation of IAQ solutions, and the current pandemic offers a host of opportunities for documenting real-world adoption and surfacing key data and lessons learned.

- **Public Awareness:** Standards and best practices are already being produced but are not resulting in implementation on the ground or awareness in the public. Groups like ASHRAE are interested in doing more in this regard and in finding ways to develop a communications strategy around

this work, helping messages reach a broader audience and drive public and private awareness outside of scientific circles.

Portfolio Approaches: Understanding Complementary Interventions

As is clear from the types of opportunities available, and some of the different types of approaches and interventions that might be pursued in response, many of the interventions outlined in this document offer complementary strengths and could amplify or mutually reinforce one another if pursued together. This is particularly true when considering a portfolio that could balance near- and long-term value – opportunities that build on current interest, momentum, and opportunity during COVID-19, while helping to build capacities and fill gaps that will enable greater impact in the future. For instance, some potential intervention pairings and complementarities could include:

- **Field Building Co-Investments:** Field building investments, such as support for field-wide strategic planning or efforts to engage more potential field funders, are inherently additive. These investment help support greater coordination and capacity among key stakeholders that improve impact across the board. This is particularly valuable alongside interventions with a longer time horizon that will benefit from future field strength, as well as alongside interventions that would otherwise have limited long-term value if not intentionally paired with strategic supports to encourage sustainability of approach.

- **Implementation Work Alongside Research Focus:** Efforts to advance real-world implementation of IAQ solutions in the near-term during COVID-19 – such as financing installations in priority settings and expanding best practices sharing and technical assistance offerings – have the potential to deliver real impact on-the-ground while demand and interest are high. However, to ensure this work also contributes to long-term strategic value requires a focus on leveraging real-world adoption to inform future efforts and fill key knowledge gaps – for instance by embedding complimentary policy or scientific research efforts into implementation work. At the same time, many of the research and knowledge gaps that stand as barriers to greater adoption of IAQ solutions can *only* be bridged by documenting real-world adoption.

- **Public Awareness Focus:** Efforts to further raise public and private awareness of IAQ issues and solutions can prove a valuable co-investment alongside many other potential interventions, helping to increase both near- and long-term impact. The public mandate for change in current moment is the strongest driving force for implementation and would be an important ingredient in advancing near-term adoption efforts. Public awareness efforts now can help create the foundation of awareness needed to be more impactful in future fights, or during the next pandemic. And field stakeholders need stronger capacity to translate research and best practices into messages that resonate with broader audiences, today and in the future – including to best leverage additional knowledge gained through other near-term interventions.

- **Sequential Policy Development Strategies and Goals:** While formal federal policy and regulation on IAQ may not materialize any time soon, it remains a core long-term field goal. Near- and medium-term efforts to develop policy at the state and local level or internationally are key potential steppingstones in building toward federal policy – and should be approached with a focus on both impact, momentum, and developing test cases and model approaches. For this reason, there is both a need for considering policy and advocacy capacity and coordination efforts in different venues, while also pairing this with longer-term federal policy research and capacities.

These types of aligned approaches reflect the broad set of gaps and needs and the benefit of interventions that can address multiple, as well as the strategic considerations and tensions between near-term opportunities and long-term goals. In addition, given the nascency of the field generally and the uncertainty over future direction and field growth, a strategy that incorporates diversified approaches may prove most prudent, given uncertainty over long-term success of any individual approach.

IV. Conclusion

This document helps to summarize the current ecosystem, analyze field gaps and needs, outline potential intervention options, and provide considerations for potential philanthropic support for this work. For philanthropic institutions considering potential investment in this area, the takeaways from this research should be clear: The current field of work is underdeveloped, leading to a very broad set of gaps and needs despite a quite timely set of opportunities for impact. Rarely is there a field where the timeliness of its work is so apparent, yet the path to achieving field goals so unclear. Philanthropic approach, then, must consider ways to support field stakeholders in taking advantage of the current moment, while also recognizing that the field needs time to grow and mature before significant impact is possible.

As such, while the interventions in this document are aimed at informing actions that could be taken during the current pandemic – and indeed many are designed to take advantage of unique opportunities currently available – they all also selected in part as ways to help support field development. Options included can help build needed capacities, fill critical knowledge gaps, and support the connections and coordination among key stakeholders that will be important to long-term field success.

We look forward to discussing this document, to understand areas of interest, to identify gaps for further analysis, and to help develop more concrete and specific recommendations for approach and investment.

APPENDICES:

Detailed Overview of Specific Potential Interventions

A: Support for Adoption of IAQ Solutions During COVID-19

This section of the report outlines potential approaches to supporting adoption of indoor air quality (IAQ) solutions by individual actors on the ground, offering the most direct potential for public health impact in the near-term while helping build key knowledge and capacities that can support long-term field goals.

The COVID-19 pandemic has increased awareness of and interest in IAQ solutions, yet for many actors, the high cost of installing HVAC upgrades, air filtration systems, or UV germicidal technologies and the relative lack of public financing options presents the single greatest barrier to adoption. This offers the opportunity for funding organizations to potentially provide financial support to actors looking to install IAQ solutions – with attention paid to public spaces with significant potential to contribute to community spread, and where philanthropic support is especially needed.

Additionally, IAQ experts note that one of the largest gaps in existing research is the lack of real-world studies of the effectiveness of IAQ solutions, or well-documented success stories and best practices that could be replicated in other areas. Addressing these information gaps will be key toward the long-term goals of scaling solutions, developing standards, further advancing technology solutions, and ultimately informing policy and regulation. Efforts by philanthropic organizations to support adoption of proven solutions in different settings could provide unique opportunities to document and learn from these real-world applications. A pilot approach could seek to document specific technologies in different high-value settings, with goals of raising awareness, demonstrating effectiveness, testing nuanced use cases and operational approaches, and building a set of findings and best practices that could be shared more broadly.

Potential Specific Interventions:

Included in this section of the report is a brief overview of the following potential approaches to supporting adoption of IAQ solutions by actors on the ground – including potential financing models, as well as elements of pilot design:

Direct Deployment of IAQ Solutions

- ***Financing IAQ Investments:*** Working with partners to identify underserved high-risk settings where IAQ investments have great potential to realize public health benefits, and for which philanthropic investment would catalyze movement. Financing models could include direct provision, open grant funding, or experimenting with performance contracts.

- ***Potential Pilot Design:*** Regardless of financing approach, supporting installation of IAQ solutions could be developed as a pilot approach, in partnership with researchers and providers, such as a quasi-experimental comparative analysis of different IAQ solutions in real-world settings.

Building Public Awareness

- ***Public Awareness Campaigns to Drive Call for Action:*** Using the current pandemic to build cultural and scientific momentum towards widespread IAQ intervention adoption will require increased public awareness of IAQ and infectious disease-related issues. A public awareness campaign informing people about IAQ solutions would be a powerful tool to drive action.

A.1 – Financing IAQ Investments

The simplest and most direct intervention that a funding institution (or group of funders) could consider would be to prioritize key public spaces and attempt to facilitate the installation of IAQ solutions directly in those priority settings. Schools are already seen by cross-sector stakeholders as priority settings for IAQ intervention and provide the clearest set of potential partners nationally and around the country with whom to work on direct installation efforts. Childcare providers offer another priority setting and potential focal area for field stakeholders, though less engagement has been pursued to date. Other potential settings to consider could include transit systems, faith-based settings such as churches and synagogues, congregate living facilities, hospitals and other health care settings, consumer settings such as restaurants, shopping malls, and movie theaters, and private offices and work settings. While limited federal funding for installations in school and other targeted settings may be available, the majority of these priority settings have few financial resources to devote to the area of IAQ.

Evaluation Considerations

Criteria:	1-5 Score:	Reasoning:
Long-Term Strategic Value	1/5	Not a sustainable long-term approach.
Real-World Impact	3/5	Direct public health impact for installation sites, but small scale.
Stakeholder Buy-In	4/5	Many potential partners, but limited current engagement.
Ease of Execution	3/5	Cost and partner identification only major barriers.
"Now or Never" Factor	5/5	COVID-19 main driver of interest among potential partners.
Total:	**16/25**	**Rating: 64%**

The main reasoning for financing IAQ investments is the combination of: (1) relative underinvestment in IAQ solutions in these settings, particularly for those in underserved areas and among at-risk populations; (2) current interest and openness among on-the-ground actors given risks and heightened awareness due to COVID-19 – factors that could potentially dissipate over time; and (3) costs and lack of available funding standing as the primary barrier to investment independent of philanthropic support.

Possible Approaches and Initial Steps:

- **Direct Provision:** Investing in installation of IAQ solutions in priority settings, such as by direct purchase of technologies – potentially in partnership with a provider – for installation and use by partner institutions on the ground.

- **Open Grant Funding***:* Open grant support made available for installation of IAQ technologies by interested actors in priority settings, potentially paired with technical assistance and/or outreach support capacities among key field stakeholders.

- **Performance Contracts***:* Partnering with providers and adopters to experiment with using performance contracts based on estimated savings as a financing model for affordable adoption of IAQ solutions.

Potential Steps: Holding substantial conversations with stakeholders who are already involved in delivery of direct interventions in a wide variety of settings, as well as those currently involved in funding installation efforts.

Considerations and Assessment:

- **Long-Term Strategic Value:** Sole reliance on philanthropic funding to finance investment in IAQ solutions is not a sustainable or scalable model in its own right. Over the medium to long-term, this type of solution must be coupled with or replaced entirely by either public funding or policy and regulatory mandates that require independent financing. Financing some installations in the near-term could, however, support efforts to fill research gaps, surface best practices, and identify scalable approaches that could support long-term goals.

- **Real-World Impact**: Depending on the specific setting selected, effective indoor IAQ solutions have the potential to significantly reduce indoor transmission of COVID-19 and the flu among key vulnerable populations. However, without matching funding or partner organizations, the direct public health impact that any individual philanthropic funder could have by directly pursuing installations is small due to the high cost of IAQ solutions relative to the number of individuals served. Broader impact is dependent on efforts to scale best practices developed through such interventions – but the success of such efforts would also be limited by available funding to support bringing those models to scale.

- **Stakeholder Buy-In:** As there are a large number of potential priority settings, representing tens of thousands of independent organizations including school districts, independent movie theaters, transit agencies, and congregate living facilities, theoretically finding installation partners should be possible. That said, the most likely place to start would be to engage field actors already advancing efforts to support adoption in schools, given existing momentum and infrastructure in that space. However, identifying other partners that are willing to fund direct installation, or potential providers willing to supply IAQ solutions at preferred rates, may be more difficult given the lack of current involvement by these stakeholders.

- **Ease of Execution**: This intervention has the benefit of being highly flexible, adaptable, and applicable in a large variety of contexts. Given the under-developed regulatory environment, there are relatively few legal barriers standing in the way of pursuing direct interventions such as this. The largest barriers, therefore, are: (1) cost (given that installation of IAQ solutions can be quite expensive, and limited funding is available to leverage); and (2) the need to identify partners eager to advance the work, given there are not currently many actors engaged in direct deployments and pilot projects. This could suggest pursuing interested providers that could offer specific IAQ technology solutions at reduced cost.

A.2 - Potential Pilot Design

Several interviewees were clear on the need to test IAQ solutions in real-world environments and suggested several potential settings as providing near-term opportunities for study given the immediate need for improved IAQ in response to COVID-19 risks. Furthermore, some settings offer standardized congregate spaces – such as gymnasiums and lunchrooms in schools – that could present natural comparative opportunities across different buildings, for purpose of analysis. Successful execution of this intervention would likely be used as additional evidence that IAQ solutions have a positive overall impact and return on investment, helping to spur future adoption and implementation.

Evaluation Considerations

Criteria:	1-5 Score:	Reasoning:
Long-Term Strategic Value	5/5	The study could form the evidence for intervention in these key settings.
Real-World Impact	5/5	The results could have major implications on pandemic response in these key settings.
Stakeholder Buy-In	1/5	This will be a difficult sell for many of the partners
Ease of Execution	2/5	While installation of the interventions is simple, a testing regime is challenging
"Now or Never" Factor	4/5	Without the COVID-19 pandemic, it is unlikely that there will be sufficient buy-in.
Total:	**17/25**	**Rating: 68%**

Possible Approaches and Initial Steps:

- **Comparative Study on IAQ Solutions:** Support installation of several types of IAQ solutions (such as portable air filters, upper room UV, HVAC upgrades, or other interventions) in similar settings, or installation of one IAQ solution in different types of settings. This can inform a follow-on study measuring the potential effectiveness in a real-world setting, while helping to better understand what environmental factors may impact different outcomes.

- **Leveraging Installation for Adjacent Studies:** Installation of IAQ solutions could also be leveraged to help study other adjacent questions or augmenting technologies. For instance, HVAC and filtration upgrades could be supported, while also providing a real-world setting to pilot monitoring technologies, automation systems, and other devices that require more development and testing. Similarly, pilots could leave the public health benefits unadulterated, while instead focusing studies on non-public health outcomes from IAQ intervention. For instance, field stakeholders note the value of studying the impact of IAQ intervention on school attendance rates, or of ridership of public transit, or of enrollment rates in day care facilities, and more.

Potential Steps: Funders looking to engage in this space should work with existing stakeholders to investigate potential options for investment in strategic pilots. This could be started by having detailed conversations that touch on specific experiment designs with some of the researchers currently involved in similar work, and working to identify potential on-the-ground partners in different settings, as well as industry partners.

Considerations and Assessment:

- **Long-Term Strategic Value:** Over the long-term, demonstrating real-world impact outside of controlled testing environments is critical to establishing a proven ROI for installation and for

public understanding of effectiveness and impact. Further, by conducting a study as a comparative analysis, greater differentiation among interventions could be created, as well as greater understanding of setting-specific best practices – helping to create clarity in the marketplace for IAQ solutions. Such a study, if effective, would help lay the groundwork for more formal regulatory frameworks, especially in settings to protect vulnerable populations.

- **Real-World Impact**: Near-term impact may be limited to the outcomes experienced by installation sites included in a study. However, the intended impact would be for study results to inform on-the-ground action by stakeholders in different settings. While this is most likely to materialize over the long-term, there is the potential during the COVID-19 pandemic for more stakeholders to be interested in potential adoption of IAQ solutions. Having a proven solution to mitigate the spread of COVID-19 in priority settings could support public awareness, policy, and implementation efforts in the near-term, while also helping inform choices by those that do adopt.

- **Stakeholder Buy-In:** Perhaps the most difficult component of this intervention would be securing stakeholder buy-in. Many stakeholders may be wary of the idea of using their facilities as test grounds, even if they are interested in receiving funding for IAQ solutions. Without a clear understanding of the relative risk of these interventions, it will likely be extremely hard to find a willing partner. This may be somewhat mitigated by the reality that almost any intervention will have some positive impact on those exposed over the status quo in almost any setting.

- **Ease of Execution**: The most significant barrier is the potential public perception caused by installing interventions that differ in effectiveness in settings with vulnerable populations. While it is known that almost any of the potential interventions being investigated would have a positive impact on reducing the spread of COVID-19 and other airborne pathogens, moral considerations must be a core concern for test design. It may also be difficult to design an accurate study, given the challenge of controlling for the many physical variables associated with installation as well as the reality of adjacent indoor and outdoor environments contributing to outcomes.

A.3 – Public Awareness Campaign on IAQ Issues and Solutions

One important leverage point to advance IAQ adoption is to increase public understanding of the impact a healthy indoor environment can have on their health, including the potential for reduced infectious disease transmission. Launching a significant public awareness campaign could fuel individual demand to improve IAQ in public and private spaces, and drive consumer action to support these changes. It can also mitigate any potential backlash to other interventions by educating the public and helping them understand the need for improved indoor environments. Such a campaign could be centered around COVID-19 response or broadened to help connect current interest and momentum to broader needs for healthier indoor air – including by connecting to reductions in influenza and the common cold, asthma, and preparedness for future pandemics. Aligned with such an effort, the Biden Administration has focused on the need to improve building performance for healthier environments, aligned with the administration's commitment to retrofit two million homes.[1]

Evaluation Considerations

Criteria:	1-5 Score:	Reasoning:
Long-Term Strategic Value	3/5	A PSA campaign could move the ecosystem, but also comes with risks.
Real-World Impact	2/5	Most impact would be indirect, and the risk of poor execution exists.
Stakeholder Buy-In	2/5	There are few current efforts, but a robust public health communications market exists
Ease of Execution	3/5	While communications campaigns are simple, the messaging challenges are significant
"Now or Never" Factor	4/5	The COVID-19 pandemic is a major potential catalyst to drive such a campaign.
Total:	**14/25**	**Rating: 56%**

Possible Approaches and Initial Steps:

- **Maintaining the Drumbeat:** The debate is already far more advanced today than it had been prior to the pandemic, given high-profile opinion pieces and open letters about the relative importance of airborne transmission of COVID-19, and the IAQ interventions that can help to combat this. Maintaining a steady drumbeat of these and other ways to reinforce the need for IAQ improvements will be essential to both near- and long-term efforts to spur adoption.

- **Driving Adoption by Public and Private Actors:** Building administrators, whether overseeing public or private spaces, are unlikely to implement costly IAQ solutions without an obvious motivating factor. And without a regulatory mandate or legal liability risk currently, pressure from the public, from customers/consumers, and from worker representatives or other stakeholders represent the clearest opportunity to push for adoption in different spaces. We have already seen the role that PTAs and unions have played in advancing IAQ intervention in schools in response to COVID-19, with much of this movement reflecting growing public awareness of the health risks and available mitigation strategies. Continuing to raise awareness – via public messaging and thought leadership, and targeted awareness building among key stakeholders with

[1] White House, "FACT SHEET: Biden-Harris Administration Launches Coalition of States and Local governments to Strengthen Building Performance Standards," January 21 2021, https://www.whitehouse.gov/briefing-room/statements-releases/2022/01/21/fact-sheet-biden-harris-administration-launches-coalition-of-states-and-local-governments-to-strengthen-building-performance-standards/

power to influence different actors – will be critical to creating the same pressure for adoption in other potential settings.

- **Campaign on Infection-Ready or Pandemic-Prepared Housing:** While IAQ interventions in private residences would have less direct impact on infectious disease transmission and community spread, it could be a tool for helping advance overall public awareness of the issues and available solutions and build pressure for change in public spaces. Several field stakeholders are invested in efforts to push for 'Healthy Homes,' with a broader set of public health benefits in mind, which aligns with Biden Administration efforts and funding for residential retrofitting. This could provide a potential vehicle for advancing IAQ awareness efforts.

Potential Steps: Potential funders should work with advocates in the space and experts in IAQ and public health fields to consider what supports may be needed to help develop and advance field public awareness efforts.

Considerations and Assessment:

- **Long-Term Strategic Value:** Raising public awareness for the need to install IAQ solutions would help advance the long-term field goals for IAQ. Adoption of IAQ solutions in public spaces at scale over the long-term will require a public mandate for both changes by building managers and policy change. And while this may not change behavior of different actors significantly in the near-term, the COVID-19 pandemic represents a particularly poignant moment to focus on raising awareness while the public is primed to pay attention.

- **Real-World Impact:** While an effective public awareness campaign can be an important tenet of broader efforts to advance IAQ solutions, the impact on the health of individuals would be indirect – save for efforts to advance residential adoption. Even if the direct impact on infectious disease transmission may be limited, greater public awareness of IAQ issues and solutions can help augment aligned efforts for implementation in different settings.

  Stakeholder Buy-In: While there are not organizations currently planning coordinated public awareness campaigns, many field stakeholders are already engaged in helping to shape the public dialogue in one way or another, and more focused and aligned efforts would likely be met with broad interest.
- **Ease of Execution:** While the stakeholders and experts needed to execute such a public awareness campaign are clear, current field stakeholders generally lack the communications and messaging capacities needed to design and execute such efforts. Additionally, given the experience of field stakeholders promoting the benefits of masking, there is some concern that IAQ issues have the potential to become unnecessarily politicized if brought into greater focus in the national debate. This potential unintended downside of public awareness efforts demands field stakeholders take particular care and nuance in messaging strategies.

B: IAQ Best Practices and Policy Development

Key actors overseeing public spaces around the country are already making important investments in technologies that can protect visitors from transmission of viruses, particularly COVID-19. Industry leaders are rapidly developing innovative technological, implementation, and financing solutions to help bring IAQ solutions to public spaces and meet this growing demand. Some of these solutions are incredibly effective and can be shared across the country, but others are unproven, ineffective, or actively harmful.

Some of the core best practices for how to improve indoor air quality (IAQ) are well known – such as general guidance on which technologies are known to be effective, what types of settings they can be most effective in, and more. However, with the ecosystem supporting adoption of IAQ solutions still in its developing phases, this type of guidance isn't always getting into the hands of those making IAQ investments and facilities management decisions.

Helping institutions and companies understand the best ways to navigate these decisions, as well as how and where there are opportunities to use public funds to support investments, is an important and timely area of needed work. This can involve supporting organizations directly by collecting research and identifying best practices amongst existing implementation efforts, helping to support broader distribution and communication of new or existing guidance and best practices, as well as focusing on longer-term policy efforts to turn best practices into more formalized policy and regulatory standards.

Potential Specific Interventions:

Included in this section of the report is a brief overview of the following potential approaches to supporting collection and dissemination of best practices and trainings for IAQ implementers, as well as potentially valuable research and policy development efforts:

Best Practices Collection and Dissemination

- ***Facilities Managers Trainings:*** Some facilities managers do not currently receive any continuing education regarding new practices for their profession. Providing professionalization of this role and designing trainings on how to best use new IAQ solutions to create safer buildings and reduce disease transmission is one avenue for impact on public spaces.

- ***Platform for Best Practices for Procurement Officers:*** Procurement officers are often responsible for decisions on how governments at all levels invest their budgets for IAQ improvements. In a market that is mostly unregulated, informing these decisionmakers of the most trustworthy and effective solutions to invest in can help focus the market on proven solutions.

Research and Policy Development

- ***Think Tank Program on IAQ Policy:*** One major gap is the lack of connection between the academic research on IAQ and policymakers understanding its implications for their decision making. A think tank program is a key part of that connective tissue for a funder to develop.

- ***Study Use of Federal Funding for IAQ Solutions During COVID-19:*** Funding from federal stimulus bills is being implemented now, and some programs will include investments in improving indoor air quality in public spaces. Evaluating the effectiveness of these investments and identifying lessons can help improve subsequent public investment.

- ***Support State-Level IAQ Policymaking:*** States can provide excellent policy experiments to inform federal action, and changes to IAQ policy are already being considered in states across the

country to respond to the COVID-19 pandemic. Supporting the passage of these experiments could be informative for future policymaking.

- ***Advancing Global IAQ Policy Dialogue:*** Aerosol viruses are not a challenge unique to any one nation, and every country can benefit from learning best practices on IAQ policy. A global conversation about potential regulations can lead to positive global impacts.

B.1 – Facilities Managers Trainings

Facilities managers for large public buildings are responsible for maintaining air systems for the building, including HVAC, air filters, and other systems that are important for maintaining clean indoor air. They can have important responsibility in identifying how and when to upgrade to a higher MERV-rating air filter, or how to manage HVAC systems to best balance energy costs with air quality management. However, many of these professionals are rarely trained on an ongoing basis to learn new technologies or practices and may not have knowledge of the updated understanding of the importance of IAQ to prevent disease transmission. Developing and providing ongoing education opportunities for facilities managers to better understand managers' role in maintaining IAQ in their buildings is one way that philanthropy can support IAQ improvements.

Evaluation Considerations

Criteria:	1-5 Score:	Reasoning:
Long-Term Strategic Value	2/5	An important task but does not ladder up as clearly to longer term goals.
Real-World Impact	4/5	Some impact is possible, but maximum impact requires adoption of IAQ solutions.
Stakeholder Buy-In	3/5	Center for Green Schools is already calling for this.
Ease of Execution	3/5	Knowledge base and network of managers already exist.
"Now or Never" Factor	2/5	This intervention does not capitalize as much on current momentum.
Total:	**12/25**	**Rating: 48%**

Possible Approaches and Initial Steps:

- **Training Materials:** Support field stakeholders to develop and disseminate training materials for facilities managers in different sectors, with a focus on how to identify and assess IAQ issues in their settings, which solutions are most effective, how to operate different technologies to achieve maximum results, and more. Importantly, this information and training materials will require ongoing reevaluation and revision as research continues to emerge in each of these areas.

- **Professionalization and Peer Learning Networks:** Support development of professionalization of facilities managers roles, particularly for public sector actors (such as in schools) where the roles have historically received limited investment. This may also include the development of peer learning networks among facilities management professionals, to develop and share best practices and lessons learned.

Potential Steps: Funders should work to investigate any existing IAQ-related training programs and work with IAQ experts to prioritize critical information for inclusion into proposed training curriculum.

Considerations and Assessment:

- **Long-Term Strategic Value:** As interest in IAQ as a vector for improving safety of indoor spaces increases among building administrators, public health officials, and the public, facilities managers will be required to implement solutions to address concerns from these stakeholders and make sure their buildings are places where people feel comfortable. Training facilities managers to understand this emerging field of work will ensure that new attention and interest in IAQ is met with the skills and expertise needed to put theory into practice.

- **Real-World Impact:** The types of systems and installations that can improve IAQ are only effective if used properly, and experts are still learning how best to optimize use – particularly when it comes to reducing transmission of airborne viruses. While training facilities managers can only go so far on its own and must be paired with technology solutions to achieve maximum impact, it is also a critical component of achieving that impact – and will only become more important as new tools and research emerge.

- **Stakeholder Buy-In:** Field actors see this as an important area for expanded support, and some are already engaged in supporting facilities manager training. Expanding these efforts could increase the capacity of this work while potentially broadening the aperture of who is eligible for these types of offerings.

- **Ease of Execution:** With the knowledge base, a clear need, and a broad set of facilities managers in different settings, this could offer a fairly straightforward path to intervention without significant costs. To achieve maximum impact, however, would require pairing training with real-world adoption of upgraded IAQ solutions, which could prove more difficult.

B.2 – Platform for Best Practices for Procurement Officers

While there is still a lot of work to do to educate policymakers about the need for IAQ solutions and how these tools can help reduce aerosol virus transmission in indoor spaces, many institutions at the state and local level are already investing in IAQ as a part of their COVID-19 response. Millions of dollars are being invested in a wide range of solutions, but in an unregulated market without clear guidance on which interventions are or are not effective. Further, procurement officers often lack the guidance they need to make informed decisions. Multiple interviewees described some products on the market as at best unproven or ineffective, and in some cases as actively harmful. An independent study of a 'needlepoint bipolar ionization' device installed in Lehigh Valley, PA schools for $1.3 million, for example, found that it had little impact on particles in the air but released volatile compounds that can cause lung and nerve damage.[2]

Evaluation Considerations

Criteria:	1-5 Score:	Reasoning:
Long-Term Strategic Value	5/5	This work would provide crucial knowledge support for central decisionmakers
Real-World Impact	4/5	This can help make an unregulated market clearer and drive coordinated purchasing
Stakeholder Buy-In	2/5	This work would require new buy-in from stakeholders, but there would likely be interest
Ease of Execution	3/5	While not a simple undertaking, the work would very quickly lead to major impact
"Now or Never" Factor	5/5	Governments are looking to purchase these solutions now, so supporting them as soon as possible is crucial
Total:	**19/25**	**Rating: 76%**

As institutions continue to invest in IAQ solutions while the market and national regulation is still developing, one way to help ensure state and local institutions are investing wisely is to develop a platform of best practices for procurement officers. Helping these crucial implementation officials understand what IAQ solutions are effective and which to avoid would make a huge difference. Such a platform could help educate procurement officers on how to avoid ineffective or dangerous technologies.

Possible Approaches and Initial Steps:

- **Develop Guide of Effective IAQ solutions:** Support field stakeholders to conduct research into the IAQ market, and to develop recommendations on which products are proven effective and safe and which are unproven, ineffective, or harmful, as well as provide guidance on how to best distinguish between the two.

- **Provide Technical Assistance for Procurement Officers:** Support field capacity to provide outreach and technical assistance to procurement officers responsible for IAQ investments, helping them understand the research on which interventions work and helping to advise on investment and installation decisions.

Potential Steps: Functioning as a clearinghouse rather than as a standalone and independent training program, pursuit of this potential intervention should be preceded by conversations with industry leaders to establish a baseline of initial advice to include in the launch of the sharing platform.

[2] Barber, Gregory, "The Ionizer in Your School May Not Do Much to Fight Covid", Wired Magazine, March 26th, 2021, https://www.wired.com/story/ionizer-school-not-fight-covid/

Considerations and Assessment:

- **Long-Term Strategic Value:** This intervention has the potential to drive a better educated, more reputable, and easier to understand private IAQ market. Institutional purchasing is often a driver for emerging markets like the IAQ market and educating procurement officers is the best way to direct the market towards more effective and safer solutions.

- **Real-World Impact:** A well-researched and widely accepted set of standards for IAQ procurement that can be provided for institutional procurement officers has the potential to have a massive positive impact in the IAQ market. Institutional purchasers are often drivers of markets, and helping these institutions understand which solutions should be supported and which will be effective for the people they serve, can make a major difference in preventing some potentially dangerous technologies from being implemented.

- **Stakeholder Buy-In:** It is not clear who currently has the expertise, stature, and capacity to effectively lead the development of such a platform. While there are organizations that do have considerable expertise, a project like this may be far outside their existing scope and constituencies. The effort would likely be partnered with an organization that has the reach to help provide such a platform to the professionals who would use it.

- **Ease of Execution:** There are two major barriers to an effective platform to provide best practices to procurement officers. First, many procurement offices have very strict rules about their purchasing processes, and so such a platform would have to be designed very carefully, in a way that is entirely agnostic of any one company or supplier, so that procurement officers can legally use what they learn from the platform and set of best practices. Second, and more importantly, there is still disagreement in the field of which interventions can be considered safe and effective. While most ventilation and filtration solutions are widely accepted as effective, there are still questions about the required level of filtration, and about other emerging technologies. For example, while UV is considered effective, some still see safety issues if deployed incorrectly.

B.3 – Think Tank Program on IAQ Policy

One of the most significant gaps in the current IAQ ecosystem is the lack of connection between the research and known solutions to reduce disease transmission in indoor environments and translating that knowledge into policy proposals and action. The current IAQ ecosystem is mostly made up of researchers and academics, along with industry players – with relatively little engagement from civil society or non-profit organizations with a stronger focus on policy, advocacy, and on-the-ground implementation efforts. A key need for field development is stronger engagement on IAQ issues by think tanks and advocacy organizations that work more directly with policymakers. Supporting such an organization to expand their work into IAQ policy or supporting current field stakeholders to add greater policy and advocacy capacities to their existing work would help fill an important missing role. Some field stakeholders are already moving in this direction, or have expressed interest in doing so, which could create opportunities for additional investment and support.

Evaluation Considerations

Criteria:	1-5 Score:	Reasoning:
Long-Term Strategic Value	5/5	A think tank program is a crucial element of a robust policy ecosystem.
Real-World Impact	3/5	Think tank development of policy can have significant long-term impact on policy and adoption.
Stakeholder Buy-In	1/5	There is almost no work currently happening in this space.
Ease of Execution	2/5	Finding the right institutional fit for this program would require extensive due diligence.
"Now or Never" Factor	3/5	A think tank taking on such a program would likely be in response to the current moment.
Total:	**14/25**	**Rating: 56%**

Possible Approaches and Initial Steps:

- **Policy Research:** Existing scientific research capacities could be augmented by support for IAQ policy research and solutions – with the focus on translating scientific knowledge into concrete recommendations for policymakers and regulators. For instance, this could be achieved via the creation of a new policy program or initiative on IAQ housed within an existing think tank.

- **Advocacy Capacity:** Beyond the need to translate scientific knowledge into actionable policy proposals, the field needs capacity for ensuring these ideas are made available to policymakers and are supported by advocacy efforts to promote policy change. This could mean increasing engagement among existing advocacy organizations with aligned missions.

Potential Steps: As a first step, any interested funder should work with IAQ experts to identify existing leading voices within the IAQ space and gauge their willingness to participate in this type of center of excellence programmatic effort.

Considerations and Assessment:

- **Long-Term Strategic Value:** If one long-term goal is advancing policy change that will bring universal adoption of IAQ solutions such as improved ventilation and filtration, starting the process of building a think tank program to develop these policies is a necessary step. Think-tanks play a crucial role in the policy and advocacy ecosystem at the federal level, create a better

structure to translate the wealth of research and known solutions into proposals for change and is an important part of the process that requires strong stakeholder support to advance.

- **Real-World Impact:** Developing a robust and effective think tank policy program to support the expansion of an IAQ advocacy ecosystem has the potential to be impactful in the long-term. While there are interventions that can be made by private actors in the short and medium-term to catalyze further investment and action across the country, in the long-term policy change will be necessary to bring IAQ to the level of universal adoption that is needed for true impact on virus transmission. Field stakeholders note that significant policy and regulatory changes are fairly unlikely in the current climate. However, this remains an important long-term goal, and developing the policy advocacy ecosystem is a crucial step to supporting these changes in the future.

- **Stakeholder Buy-In:** Field stakeholders strongly agree that developing greater policy and advocacy capacity is a key need – but finding the right institutions to carry that work may prove to be the barrier. Some organizations have already begun to move in this direction and could offer an initial set of potential partners.
- **Ease of Execution:** With little existing work being done in the IAQ policy space as it relates to disease transmission, it would likely take time and funding to develop a robust policy program to support IAQ policy development and advocacy at an institutional level. Institutions may also be skeptical about taking on IAQ policy as a new program area, as there is not much existing infrastructure for them to build upon.

B.4 – Study Use of Federal Funding for IAQ Solutions During COVID-19

Given the cost of IAQ investments and relative lack of current available funding, field stakeholders note that a key need is to promote availability of public funding for IAQ investments in public spaces. Importantly, two pieces of recent federal legislation – the American Rescue Plan (ARP) and the Infrastructure Investment and Jobs Act (IIJA) – included temporary funding streams that could theoretically be used to support investment in IAQ solutions in select settings.

Evaluation Considerations

Criteria:	1-5 Score:	Reasoning:
Long-Term Strategic Value	4/5	Evidence of effective public spending can inform future public investments.
Real-World Impact	3/5	Evaluation of investment effectiveness can catalyze and inform future policymaking.
Stakeholder Buy-In	3/5	A lot of work is already being done to analyze and support ARP and IIJA spending.
Ease of Execution	4/5	This would be a simple grant to a research organization to lead this work.
"Now or Never" Factor	5/5	With these spending bills being implemented now, studies to inform effective investment of funds are very time sensitive.
Total:	**19/25**	**Rating: 76%**

ARP included significant funding to support schools in getting through the pandemic and creating safe environments for students to return to in-person education, and one of the major categories of allowed spending laid out by the Department of Education is improving IAQ systems to create safer classroom environments for students. Similarly, IIJA included several funding streams which could potentially support IAQ investments in different settings, including schools, places of worship, and public housing – though this funding is less directly focused on this type of use case.[3] ARP funding has already been allocated and school districts are still actively administering these funds – including investments in HVAC upgrades.[4] IIJA was passed more recently and is much earlier in the implementation process.

While it will be important for field stakeholders to help on-the-ground actors access and use this funding (a key a goal of technical assistance supports that could be provided to procurement officers, as suggested elsewhere in this report), it will also be critical to ensure that the real-world use of this funding is studied, and best practices captured. To date, relatively little research has been pursued to understand the IAQ relevant investments being made using ARP funding. Field efforts to help design and advocate for future and more permanent IAQ funding sources will benefit greatly from near-term efforts to maximize currently available funding and understand its effectiveness.

Possible Approaches and Initial Steps:

- **Schools-Based IAQ Intervention Analysis:** Analyze data from the Department of Education and local school districts to identify local IAQ solutions and use of ARP funding. Consider targeted studies on what types of IAQ solutions are being installed using federal funds, how this differs across geographies, the rate at which unproven solutions – such as ionizers – are being adopted, and overall program success and intervention effectiveness.

[3] For more information on IAQ relevant funding in ARP and IIJA, see the accompanying landscape report, "Ecosystem Mapping, Analysis and Implications".
[4] Burbio ESSER III Spending Tracker, https://info.burbio.com/esser-iii-spending/

- **Informing Infrastructure Funding Use:** Leverage known best practices and lessons learned from use of ARP funding to inform rulemaking on use of IIJA funding on IAQ solutions, and to inform use of funds by actors on-the-ground.

Potential Steps: Potential funders should begin to investigate this field by working with partners to understand existing scholarship on ARP funding usage and surfacing lessons from existing beneficiaries of the program to help inventory successes.

Considerations and Assessment:

- **Long-Term Strategic Value:** Building up an evidence base of effective public spending practices on IAQ solutions will contribute to future advocacy efforts, as it can provide support for further investment. Supporting studies like these can also be a precursor to more in depth IAQ policy efforts and encourage organizations to take on the issue as a focus area.

- **Real-World Impact:** A well-designed and executed study of the effectiveness of school district investment of ARP funds could be useful to actors on-the-ground, including in the near- and medium-term as ARP funds continue to be administered and as infrastructure funding potentially becomes available for relevant IAQ uses. A study of this type could have the added benefit of making actors more aware of the availability of applicable funds and potential uses.

- **Stakeholder Buy-In:** Stakeholders agree that poor implementation of existing funds, including investment by some on-the-ground actors in ineffective or even harmful IAQ solutions, has the potential to set the movement back – including by negatively impacting prospects for future IAQ funding. Some organizations are already supporting school districts with IAQ best practices and technical assistance and could be well positioned to advance this type of research. Additionally, there are a host of major policy organizations and nonprofits doing significant work related to ARP and IIJA implementation, including on evaluation – providing a large set of other potential partners.

- **Ease of Execution:** Research of this type would be timely, and while ease of execution would depend on the depth of study, it could be scoped in a way that fits with partner interest. It is possible that available information and data may prove insufficient, and the disaggregated environment of individual school districts could make new data collection especially difficult. Some private consulting firms have already conducted relevant initial tracking of ARP funds and use in schools, which could provide an initial basis for future research.[5]

[5] For instance: Burbio ESSER III Spending Tracker, https://info.burbio.com/esser-iii-spending/

B.5 – Support State-Level IAQ Policymaking

The implementation of federal IAQ policy has been identified by experts and stakeholders across the IAQ landscape as an essential step towards widespread IAQ intervention adoption. However, experts have also noted the complexity and long time to impact with policy implementation that make change at the federal level a difficult undertaking. In the meantime, many states are already considering — and in some cases implementing — IAQ policies, providing an important set of near- and medium-term opportunities for advancing field policy goals. Field experts drew attention to the favorable IAQ policy landscape in California specifically, among a handful of states with pending legislation,[6] as offering the potential for movement. While some field stakeholders are involved in policy discussions in these states, additional capacity, field focus, and support for this work could help advance stronger policy and advocacy efforts – including as an important down payment toward longer-term efforts nationally.

Evaluation Considerations

Criteria:	1-5 Score:	Reasoning:
Long-Term Strategic Value	4/5	State level policymaking can set the stage and test ideas for national action.
Real-World Impact	4/5	Advancing policy in states can directly impact millions of buildings across these states.
Stakeholder Buy-In	3/5	There are already some organizations engaged, and more would come to the table with support.
Ease of Execution	2/5	These policy efforts are moving naturally already in legislatures, but results are not guaranteed.
"Now or Never" Factor	5/5	The debates are during current state legislative sessions, which only last a few months.
Total:	**18/25**	**Rating: 72%**

Possible Approaches and Initial Steps:

- **Deeper Engagement in State Policymaking:** Additional field focus could be paid to building connections with policymakers in relevant states – potentially with a specific focus on ongoing policy efforts in California – and helping to develop state-specific policy proposals informed by latest IAQ research. Some organizations already advance work in this regard, but to date these efforts have been more ad hoc and reactive in response to policymaker interest and could be more impactful with greater support and coordination.

- **Development of Model Legislation:** As more states consider potential policy on IAQ, evaluating past bills and developing a model for future policy could help speed up legislative change around the country. For instance, this could be the focus of a policy working group, convened by a field leader.

- **Playing Defense:** Some field stakeholders have noted that some industry representatives are further ahead of public interest advocates in engaging with state policymakers on IAQ-related issues. The result is advancement of counter-productive policies with relatively little capacity by IAQ stakeholders to push back. For instance, this can be seen in the expansion of safe-harbors against liability for COVID-19 transmission that have cropped in different states.

[6] Anecdotally, interviewees noted that legislation on IAQ policy is currently under consideration in as many as six to eight states – with specific mention of California and Maryland as places where some amount of policy may have traction.

Potential Steps: Potential funders should engage with state-based stakeholder-specific organizations and legislators to understand the local regulatory environment and aid existing efforts with the option to expand efforts to more generally cover the IAQ space.

Considerations and Assessment:

- **Long-Term Strategic Value:** Supporting the institution of IAQ policies in states will not only drive widespread adoption in those states, but also lay the foundation for policy movement elsewhere in the country. As federal policy implementation has been routinely acknowledged as critical for long-term success in achieving widespread IAQ intervention adoption, starting at the state level is a tangible way to begin to lay the groundwork for eventual federal adoption.

- **Real-World Impact:** The Maryland General Assembly is currently negotiating House Bill 85 which, if passed, would provide a state tax credit for 50% of the costs incurred during purchase and installation of IAQ solutions in residential spaces and small business commercial buildings. With cost as a primary factor for IAQ intervention hesitation amongst stakeholders, and incorrect installation as a leading cause of negative implications of IAQ intervention installation, this bill has the potential to make a significant real-world impact. Additionally, one expert noted a bill specifically focused on IAQ safety in schools currently being drafted in the Maryland General Assembly. In 2020, California passed AB 841, a larger energy efficiency/COVID-19 bill which also included standards for safe IAQ in schools. These examples showcase the real-world impact that partaking in IAQ policy work can accomplish.

- **Stakeholder Buy-In:** In addition to collaborating with IAQ focused and tangentially related entities in both California and Maryland, experts note that coordination with other stakeholders would be beneficial for identifying other states looking at progressive IAQ policies.

- **Ease of Execution:** Because California and Maryland already have the foundation for IAQ policy, (there are laws in place/bills drafted/policymaker support for IAQ legislation) tangible grantmaking opportunities exist. Thus, giving clear direction on where funding can go and the infrastructure to make those investments. But with any policy work, supporting this initiative is not a guarantee for successful implementation. California and Maryland have a history of successful IAQ policy implementation, but there is always the potential for stakeholder and policymaker opposition which could lead to unsuccessful execution.

B.6 – Advancing Global IAQ Policy Dialogue

Currently, very few countries have established policy and regulatory regimes on indoor air. While early-stage policy dialogues are ongoing in some arenas, including some promising developments in the EU and some existing IAQ regulations in East Asian countries, IAQ policy around the world is underdeveloped and often nonexistent, despite decades of scientific research on the issues and needed interventions. Given the lack of existing policy in this regard, countries that do show interest in pursuing new regulations have few, if any, models from which to learn.

Evaluation Considerations

Criteria:	1-5 Score:	Reasoning:
Long-Term Strategic Value	4/5	Can drive discussion around the world.
Real-World Impact	2/5	Likely level of uptake of recommendations is low.
Stakeholder Buy-In	2/5	Would require buy-in from national policymakers to attend.
Ease of Execution	2/5	Would require significant work to put together.
"Now or Never" Factor	3/5	COVID-19 would be a likely motivator for this convening.
Total:	**13/25**	**Rating: 52%**

Given new interest in these issues due to COVID-19, opportunities exist to help advance policy and regulatory development globally. Even if formal policy in the U.S. specifically may be unlikely in the near-term, advancing IAQ policy in other countries can be an important tool for seeding policy dialogue in the U.S. in the medium- and long-term. Some field stakeholders have suggested value in convening scientists and policymakers from around the world to develop a set of guidelines and best practices for regulators to consider and implement, which could be an effective way to jumpstart global policymaking. Creating shared international standards would help each regulator have a base to work from and create political cover within countries for why regulations are moving forward.

Possible Approaches and Initial Steps:

- **International IAQ Policy Working Group:** Just as in the U.S., the international research community focused on IAQ is well-developed, but work to translate that research into concrete policy efforts has so far been limited. Work to connect and convene IAQ experts and policy thinkers globally – such as an international IAQ policy working group, with a specific focus on developing policy and engaging with government actors – could help bridge current ecosystem gaps. Some field stakeholders, such as the WHO,[7] have begun efforts in this regard which could be built upon and expanded.

- **Coordinate Efforts on International Policy Opportunities:** As countries consider potential policy approaches to IAQ, such as the ongoing process in the EU,[8] researchers and policy thinkers have opportunities for collective impact, but this may require focused support for strategic policy engagement, tracking, and coordination capacities that are limited in the current

[7] "Roadmap to improve and ensure good indoor ventilation in the context of COVID-19", WHO, March 1st, 2021, https://www.who.int/publications/i/item/9789240021280

[8] Zimmerman, Antonia, "COVID-19Spurs Efforts to Clean Up Indoor Air", Politico EU, January 14th, 2022, https://www.politico.eu/article/covid19-coronavirus-spurs-efforts-to-clean-up-indoor-air/

field. This could also include supporting the development of standard policy guides that could be applicable across international regulatory regimes.

Potential Steps: Potential funders should begin probing this sub-field within the IAQ space by engaging in exploratory conversations with key regulators to better understand the appetite among the existing regulators (at the federal and international levels) to implement wide-ranging IAQ regulatory frameworks.

Considerations and Assessment:

- **Long-Term Strategic Value:** Advancing IAQ policy around the globe is an important outcome on its own. But this also can have strategic value in the U.S. context. Ultimately, while formal IAQ policy and regulation at the federal level in the U.S. is an important long-term field goal, stakeholders agree that this will likely not be realized any time soon given current political realities and long-standing cultural barriers against regulating private spaces. However, for the policy environment in the U.S. to change long-term, several stakeholders believe policy movement internationally may be a necessary prerequisite – providing political cover, creating momentum for change, and providing a foundation of model policies with proven track records. Policy movement internationally may be a long way off as well, but the current moment offers the most obvious opportunity to jump start those discussions – even if the opportunities for intervention in the near-term are small initial steps.

- **Real-World Impact:** The potential impact convening stakeholders and supporting coordination and dialogue is unclear. However, development of a clear set of rules that could be easily imported to countries around the world would be an important step to the kind of impactful policy change that is ultimately needed – and given COVID-19, there is some reason to believe that policy change in some places may be possible, even if it is unlikely in the U.S. specifically.

- **Stakeholder Buy-In:** Some potential partners exist for supporting international dialogue and policy development work, and some actors have ongoing related work on IAQ research, policy, and standards that could be supported and expanded upon. This would be a natural next step for these organizations to take, and they would likely have the connections in nations around the world to bring the right players to the table. However, success relies on national policymaker buy-in which may be difficult to gain.

- **Ease of Execution:** While seeing actual policy change anywhere may prove difficult, some initial steps to support field development and advance the dialogue – such as convening actors or supporting capacity for coordinated policy engagement – are relatively light lift, assuming interest of field stakeholders and potential partners.

C: Field Building and Stakeholder Engagement

This section of the report outlines potential approaches to raising awareness of indoor air quality (IAQ) solutions among a variety of key stakeholders with important potential roles in advancing IAQ adoption. The COVID-19 pandemic has increased awareness of and interest in IAQ generally, but for the most part this has occurred organically and in an ad hoc way, rather than resulting from coordinated, targeted, and strategic engagement efforts. This presents an opportunity for field stakeholders, with funder support, to focus more directly on raising awareness among key audiences, with a goal of bringing important partners to the table to strengthen efforts to promote adoption of IAQ solutions. Attention can be paid to different communication outlets, types of stakeholders, and unique communication ecosystems that may be setting specific goals within the landscape.

Additionally, IAQ experts note that one of the largest gaps in the existing IAQ ecosystem is between what is understood by researchers about airborne transmission of infectious diseases and what is understood by those with the power to advance implementation efforts on the ground. The interventions offered in this report would seek to expand public understanding of the effectiveness of these solutions, give decisionmakers the tools to correctly assess and mitigate risk in their corresponding facilities, and raise awareness of the risks that poor IAQ can pose for populations in high-risk settings. This last application also has the potential to mobilize grassroots support for IAQ solutions amongst stakeholder groups that themselves have a stake in the quality of IAQ in certain settings.

Potential Specific Interventions:

Included in this section of the report is a brief overview of the following potential approaches to developing and deploying external stakeholder awareness campaigns:

Field Growth and Development

- ***Field Strategic Planning and Coordination:*** Initiative to mature the IAQ ecosystem by conducting field strategic planning and coordination amongst stakeholders through cohesive ecosystem mapping and/or convening of stakeholders.

- ***Engagement with Potential Allied Funding Organizations:*** Targeted efforts to bring potentially allied funders further into IAQ related work, including early-stage informal outreach, and potential development of a forum for philanthropic coordination in the medium- or long-term.

Engaging New Stakeholders

- ***Collaboration with Plaintiff Lawyers for IAQ Liability:*** Proactive engagement with legal community to support development of precedents and laws regarding liability for adverse outcomes due to poor IAQ and to create incentives for IAQ investment.

- ***Supporting Prominence of the Healthy Buildings Movement:*** Working with existing standard setting organizations to align on incorporation of IAQ standards into green building standards and further building the healthy buildings movement in a similar model.

C.1 Field Strategic Planning and Coordination

The IAQ ecosystem is relatively diffuse, with a lot of different actors engaged tangentially, but few directly engaged. And while there is a significant number of actors, especially with new interest and attention to this space, the work is disaggregated and often occurring in silos. Interviewees agree that greater collective impact is possible, but that this will require dedicated focus among field stakeholders to better understand the ecosystem and actors' roles, to develop shared priorities and approaches, and to work together on coordinated campaigns. This suggests value in supporting field strategic planning and coordination amongst actors in the IAQ landscape, as a key field building support that can help drive impact.

Evaluation Considerations

Criteria:	1-5 Score:	Reasoning:
Long-Term Strategic Value	5/5	Accomplishing this would be extremely beneficial for the ecosystem.
Real-World Impact	3/5	There is the potential for significant real-world impact in the long-term.
Stakeholder Buy-In	4/5	Likely to be high level of buy-in from stakeholders.
Ease of Execution	2/5	May be difficult and take a long time to execute.
"Now or Never" Factor	4/5	More actors are engaged in the space because of COVID-19.
Total:	**18/25**	**Rating: 72%**

Possible Approaches and Initial Steps:

- **Convening of Stakeholders:** Many experts in the IAQ field noted the lack of conversations currently happening amongst stakeholders. In order to drive field strategic planning and coordination, one approach may be to convene stakeholders and begin these critical discussions about gaps, roles, and current and future shared goals.

- **Comprehensive Ecosystem Mapping:** Some ecosystem mapping has already been pursued, with initial insights, actors, gaps, and intervention points identified in this report. However, one approach to field strategic planning and coordination could be to build out a more comprehensive ecosystem mapping in order to better understand the IAQ landscape, and to more thoroughly analyze potential opportunities for impact.

Potential Steps: Potential funders should engage core field leaders to understand interests in convening and strategic planning supports, to identify a potential convener, and to consider who to have at the table.

Considerations and Assessment:

- **Long-Term Strategic Value:** Field strategic planning and coordination have the potential for significant long-term strategic value. By both conducting field strategic planning and coordinating stakeholders, the potential for knowledge sharing and important partnerships can be realized, and the field as a whole will be better equipped and aligned on strategies for advancing IAQ solution adoption.

- **Real-World Impact:** Particularly as the ecosystem evolves and more actors enter the space, having a more clearly defined and coordinated understanding of stakeholders enables actors to assess the landscape, form partnerships, fill identified gaps, and generally be more effective in the space. Although this intervention does not result in direct IAQ solution adoption, it lays the foundation for a more effective landscape which can then work to deliver significant impact.

- **Stakeholder Buy-In:** Strategic field planning and coordination was highlighted as a need by many experts in the IAQ landscape, thus indicating that stakeholder buy-in would be high for this intervention. Several interviewees noted personal interest in participating in such a process.

- **Ease of Execution:** Because the IAQ ecosystem is relatively diffuse, with few core actors, it may be difficult to identify exactly which actors could or should be involved in such work, and in early discussions with field stakeholders, no natural convener has been readily identified.

C.2 – Engagement with Potential Allied Funding Organizations

With only a few foundations actively writing about and beginning to fund projects in the IAQ space, greater awareness of the issue among potential funders is a necessary prerequisite for field growth and development that can advance adoption of IAQ solutions. At the same time, many philanthropic organizations fund in aligned fields – public health, children's health and development, K-12 education, and more – suggesting great potential for additional funding interest if key stakeholders are engaged in relevant allied efforts and opportunities. Additionally, given that IAQ issues are addressed independently in different settings each with different stakeholders, the siloed nature of this work means that a broad array of funders may potentially be engaged in IAQ- related work without being connected with other funders involved in related work in other spaces. These factors suggest a need for greater focus by current stakeholders in the IAQ field on proactive outreach and engagement with potentially allied funding organizations – particularly including outreach by current field funders.

Evaluation Considerations

Criteria:	1-5 Score:	Reasoning:
Long-Term Strategic Value	4/5	Creating a unified funding strategy for IAQ would be a massive win for the space.
Real-World Impact	2/5	Direct impact of this would be minimal.
Stakeholder Buy-In	1/5	Philanthropies are not currently plugged into or primed to engage in this area.
Ease of Execution	2/5	The timeline to impact is longer than ideal.
"Now or Never" Factor	4/5	Philanthropies are more likely to be involved in a convening body now during COVID-19.
Total:	**13/25**	**Rating: 52%**

Possible Approaches and Initial Steps:

- **Informal Early-Stage Outreach:** The limited current presence of institutional funders suggests that an initial focus of funder engagement efforts could be early-stage informal and lower-commitment conversations with natural allies, such as public health focused funders.

- **IAQ Funder Coordination:** Longer-term, core IAQ funders could consider developing more formal partnerships or coordination infrastructure. This could be via a regularly convening body that becomes an authority within the philanthropic IAQ space, or more opportunistic convenings on specific initiatives, to include bridging with more tangentially aligned funders and domains.

Potential Steps: Potential funders should begin their investigation of this space by inventorying all other major organizations that are funding within this space. Engaging in conversations with several key stakeholders within this space will then give potential funders a better understanding of any groupings or alliances already existing in IAQ funding.

Considerations and Assessment:

- **Long-Term Strategic Value:** Outreach and engagement with allied funders has the potential to help grow the funding available to field stakeholders and support long-term capacity building needs and scalability of approaches. This will help to bring additional expertise and networks to bear in a field that currently lacks engagement by allied stakeholders in other domains. Further,

funder outreach may be a particularly important lever at helping to ensure that near-term efforts to expand IAQ adoption are met by growing and sustained focus on the field over time. A more formal convening body could coordinate on long-term field building strategies and theories of change, align on priority settings for interventions, and collectively exert greater pressure on the current regulatory regime than any individual organization could accomplish on their own.

- **Real-World Impact:** While this intervention is perhaps the most distanced from direct impact on public health outcomes, it does have significant potential for growing the impact of the field, as well as of individual potential initiatives that can reach greater scale and leverage with more partners. Therefore, engagement with other potentially interested funders is an important complement to any philanthropic investment in IAQ related work, including many of those listed in this report.

- **Stakeholder Buy-In:** With limited current engagement in the IAQ space by other funders, it may be difficult to find interested partners in the near-term – but the risk of outreach and engagement is still relatively low. As more philanthropic organizations enter the field, buy-in to pursue more concrete, specific, and coordinated efforts as well as more formal coordination infrastructure may occur organically, or may require focus and effort among key field evangelists.

- **Ease of Execution:** Funder outreach can be a relatively low-stakes engagement, but success is dependent on several factors, and may be relatively low in the near-term given the lack of obvious high-impact investment vehicles currently available. For this reason, funder engagement efforts may first require identifying a specific initiative that may interest funders in a given domain. For instance, an initiative related to IAQ investments in schools could be brought to organizations like unions, child advocacy organizations, and educational philanthropic entities as a starting point to create future partnerships.

C.3 – Collaborate with Plaintiff Lawyers for IAQ Liability

Building administrators and private employers are expected to know the potential dangers of airborne disease transmission in their workplaces. However, these key actors do not always make the kinds of investments in improving IAQ that may help reduce transmission, due to a current lack of regulatory mandates or obvious legal liability. In the case of COVID-19, many states have created legal safe-harbors to protect employers from liability as long as their workplaces comply with state health guidelines, which do not have set IAQ standards.

Evaluation Considerations

Criteria:	1-5 Score:	Reasoning:
Long-Term Strategic Value	4/5	Potentially groundbreaking in terms of liability associated with COVID-19 nationwide.
Real-World Impact	4/5	Success may lead to massive overhauls to implement IAQ solutions.
Stakeholder Buy-In	2/5	May be difficult to find legal partners.
Ease of Execution	1/5	Would require substantial effort and investment to successfully enact.
"Now or Never" Factor	5/5	COVID-19 is the core precipitating factor.
Total:	**16/25**	**Rating: 64%**

Plaintiff lawyers play an important role in helping set liability precedents via legal avenues, such as class action lawsuits that demonstrate harm and neglect. This policy lever is particularly relevant in issue areas where legislation and regulation are unlikely, and where personal injury and negative health outcomes are in play. By supporting or facilitating class action lawsuits in settings where flu or COVID-19 transmission has occurred as a result of poor ventilation and air filtration, a liability standard for IAQ solutions could be created. Similar precedent exists – for instance, as settings where heavy cardio activity occurs, gyms almost universally adopted the installation of automated external defibrillators (AEDs) as a precaution, and lawsuits later made it a liability to not have an AED.

Possible Approaches and Initial Steps:

- **Collaborate with Plaintiff Lawyers for IAQ Liability:** Field stakeholders and funders could engage with legal partners to create the structure for potential class action lawsuits, including identifying plaintiffs, coordinating with scientists, and researching relevant precedents.

- **Protecting Against Safe Harbor Rules:** Additionally, this work could include engaging with federal and state regulators to support reforms to existing COVID-19 related safe-harbor rules, or to support efforts aimed at ensuring similar rules do not arise in other jurisdictions.

Potential Steps: Potential funders should review case-law on COVID-19 related liability cases to evaluate the extent to which this is already an active area of litigation. Potential funders should also speak with legislators about proposed and implemented COVID-19 liability safe-harbor rules.

Considerations and Assessment:

- **Long-Term Strategic Value:** The creation of a legal precedent would result in an immediate impact and offers a potential avenue for developing standards and mandates of IAQ in public and private spaces without the need for formal legislative or administrative policy change. That said,

legal liability would likely only cover certain elements of IAQ in certain spaces and is therefore not necessarily a replacement for formal policy that could be more expansive. To the extent that legal liability reduces the political imperative for advancing overall policy, it is possible such efforts could undermine a subset of longer-term field goals.

- **Real-World Impact:** Establishing a legal precedent for liability for airborne virus transmission, especially if it were a large-scale class-action lawsuit, has the potential to catalyze IAQ investments in a variety of settings. However, it is also possible that the current research base is not strong enough to directly link poor IAQ to virus transmission, and understandings of IAQ solutions is not well formed nor widely understood enough to hold non-adopters legally liable. This could suggest that, while class action lawsuits are an important potential lever, the real-world impact of this approach or application of resulting liability standards could be slow to materialize.

- **Stakeholder Buy-In:** Unions representing workers in high-risk settings would likely be the most natural partners, along with law firms willing to take on these types of class-action cases. The unions would also likely carry considerable political weight, enabling meaningful engagement with state lawmakers as needed to reform safe-harbor laws for optimal IAQ outcomes. Coordinating with these stakeholders, however, could require significant effort on the part of external stakeholders or funders.

- **Ease of Execution:** There are several barriers to executing such a strategy. First, state safe-harbor laws may create barriers to engage in this kind of lawsuit, particularly as it relates to COVID-19 transmission. Second, the connections made between IAQ and virus transmission may be too tenuous to warrant legal action without further development of underlying research – and with COVID-19 specifically, the high rate of community spread could make proving a transmission occurred in a specific setting especially difficult. Third, in part due to the difficulty of drawing direct causal links, it could prove difficult to identify plaintiffs with sufficient standing to file suit or attorneys interested in supporting.

C.4 — Support Prominence of the Healthy Buildings Movement

The green building movement has generated significant interest over the past several decades and is increasingly being integrated into standard building practices for many private companies and government entities. This model for change in building standards can be used to catalyze the growth of the healthy buildings movement, and to support broader adoption of filtration and ventilation systems that can protect building occupants from infectious diseases. In the past, energy efficiency and improved indoor air quality have been seen as competing efforts, with technology to improve indoor environments drawing more energy. However, new technology is resolving this tension and creating new opportunities to improve IAQ and be energy efficient. These aligned movements can work together, and the healthy buildings movement can learn lessons from the green building movement.

Evaluation Considerations

Criteria:	1-5 Score:	Reasoning:
Long-Term Strategic Value	3/5	Effective implementation could increase adoption of IAQ solutions.
Real-World Impact	3/5	Growing this movement could improve understanding of the need for better IAQ.
Stakeholder Buy-In	2/5	Additional integration with the green buildings movement would be challenging.
Ease of Execution	2/5	Competition with green buildings movement is a significant barrier.
"Now or Never" Factor	2/5	The high information level among activists means it is not central.
Total:	**12/25**	**Rating: 48%**

Possible Approaches and Initial Steps:

- **Further Integrate Green Buildings and Healthy Buildings:** By working with green building councils to have IAQ goals formally incorporated into their human-centered design elements, field stakeholders have the potential to leverage existing attention and momentum for green buildings to advance IAQ improvement efforts.

- **Support Adoption and Transparency of IAQ Ratings**: The success of LEED ratings can be an important model, and organizations like the International WELL Building Institute (IWBI) are already developing similar rating systems for healthy buildings which include IAQ goals. Promoting an effective and well-developed rating system to build similar legitimacy, and incentivizing buildings to improve their healthy building ratings, could help accelerate the healthy buildings movement and build greater public awareness of IAQ in public spaces.

Potential Steps: Potential funders should work with healthy building movement leaders to support growth of the prominence of their work. They should also connect with green building leaders to understand how IAQ standards are already included in their movement and how else to further integrate the two campaigns.

Considerations and Assessment:

- **Long-Term Strategic Value:** Growth of the healthy buildings movement, and integration with the green buildings movement, could lead to increased adoption of solutions to improve IAQ. In particular, field stakeholders note that perceived tensions and competition between energy efficiency goals and IAQ improvement goals stand as a key barrier to advancement of IAQ efforts, particularly given the strength and prominence of the sustainability movement. That said,

key sustainability advocates are generally supportive of healthy buildings efforts, presenting opportunity to pursue greater alignment between the two movements, which could end-run some of these concerns while providing a stronger vehicle for advancing IAQ goals over the long-term.

- **Real-World Impact:** The impact that LEED has had on advancing adoption of sustainability practices has been clear. With effective development, promotion, and incorporation into sustainability movement efforts, healthy buildings ratings could be a powerful tool for helping to advance adoption. In particular, if healthy building ratings with IAQ intervention standards were incorporated into major green building design standardizations, it would likely result in a large increase in the installation of IAQ solutions across a wide variety of new construction builds. However, this may also rely on further development of IAQ research on effectiveness and ROI of specific interventions.

- **Stakeholder Buy-In:** LEED certification standards are the most widely used, and thus a partnership with the green building movement would be the most sensible for a potential funder. However, some stakeholders at times see energy efficiency efforts and IAQ intervention in tension, as increasing energy efficiency is often easier with lower levels of air circulation and HVAC energy usage. Despite this, key sustainability stakeholders are already supporting of IAQ goals. Actors in the healthy buildings movement would likely be open to working with funders and other stakeholders to disseminate health building ratings.

- **Ease of Execution:** One large barrier to implementing this intervention is the current lack of clarity with potential health building ratings. For buildings to display their healthy building rating and interventions, the movement must first solidify their rating scale and the criteria for each category. Further, given the many priorities that green building organizations are already pushing with the scale of the climate crisis, convincing them to also prioritize healthy buildings and IAQ goals could be a challenge.

D: Research Efforts to Fill Key IAQ Knowledge Gaps

This section of the report outlines potential approaches to addressing the research gaps that inhibit widespread adoption of indoor air quality (IAQ) solutions. A mix of short and medium-term potential interventions, all the solutions in this section support the long-term goal of widespread adoption by addressing the research gaps for a variety of stakeholders.

The research community is well-developed in comparison to other sectors of the IAQ ecosystem. In academia, the consensus on the impact of poor IAQ is clear: it negatively impacts our health, productivity, and wellbeing. While the research community is mature, there are still several gaps as identified by experts in the IAQ landscape that must be filled to achieve more universal adoption and optimized implementation of IAQ solutions. In particular, there is greater need for real world testing on effectiveness of different IAQ interventions, standardized testing and further development of emerging technologies and less proven interventions, and the need to leverage this and other research to develop agreed upon standards for IAQ.

Importantly, the current pandemic could potentially offer key opportunities to help address these research gaps by leveraging real-world adoption of IAQ solutions.

Potential Specific Interventions:

Included in this section of the report is a brief overview of the following potential approaches to closing the existing gaps in IAQ research, including potential research opportunities to advance IAQ field development, aid consumers, and address technological elements.

IAQ Effectiveness

- ***Studies to Develop ROI Proof Points:*** Funding studies to identify ROI Proof Points on IAQ solutions for consumers. Potential approaches include: ROI for Different Settings, Comparison Across Products, Infectious Disease Impacts, and Health Cost Modeling.

- ***Real-World Studies on IAQ Intervention Effectiveness:*** Investing in research that tests IAQ solutions for real-world efficacy.

Testing and Standards Development

- ***Developing Recommended IAQ Standards:*** Producing recommended standards within the IAQ research and scientific communities.

- ***Industry-Wide Testing Standards:*** Aiding in the development of agreed upon standards within the IAQ development industry.

- ***Research to Support Development of IAQ Technologies:*** Filling the IAQ technological research gap by funding research to design and develop technologies such as safe UV and viral monitoring and rapid identification devices.

D.1 – Studies to Develop ROI Proof Points

Given the high cost of IAQ solutions relative to other facilities management costs and given the lack of policies and regulation mandating indoor air standards, demonstrating the return on investment (ROI) of such investments will be a critical factor in promoting adoption. It is known that IAQ solutions can help reduce transmission of infectious diseases, among a host of public health outcomes, implying reduced health costs, fewer employee sick days, and other quantifiable benefits, while also helping to improve worker productivity and improve student educational outcomes. But while these benefits are known in the abstract, and some modeling has been done to attempt to quantify the value of improved IAQ generally, questions remain about the real-world outcomes that any actor can expect to realize when adopting IAQ solutions, such as HVAC upgrades, air filters, or installing UV technologies.

Evaluation Considerations

Criteria:	1-5 Score:	Reasoning:
Long-Term Strategic Value	4/5	Additional ROI proof-points could change the way that companies consider IAQ solutions as investments.
Real-World Impact	2/5	While there is significant potential downstream impact, ROI proof-points on its own will not create change.
Stakeholder Buy-In	4/5	ROI discussions would be welcomed by the research community, and decisionmakers.
Ease of Execution	3/5	Calculating and maintaining experimental accuracy in ROI studies is difficult.
"Now or Never" Factor	4/5	The continuation of the COVID-19 pandemic makes the results of this research more powerful.
Total:	**17/25**	**Rating: 68%**

By developing ROI proof points, actors will be more inclined to adopt IAQ solutions in their spaces as they can confidently measure the positive effects of the intervention and ensure it delivers the intended value (and could help inform development of financing structures). Furthermore, developing ROI proof points will be useful for stakeholders who already have implemented IAQ solutions as they can determine whether their current interventions are meeting their needs and subsequently determine if they need to make changes or additions.

Possible Approaches and Initial Steps:

- **ROI for Different Settings:** The ROI that can be realized in one setting may be very different than ROIs that can be achieved in different settings, even if the same IAQ solution is being employed. This suggests the need to design studies for specific use cases and types of spaces where the costs of poor IAQ are more directly borne by the implementing actors, such as office buildings.

- **Comparison Across Products:** Developing ROI calculations alongside effectiveness studies can help actors understand not just the raw impact of different interventions, but also the return on investment that can inform decisions and promote action.

- **Infectious Disease Impacts:** Some studies have been conducted to model and quantify the benefits of improved IAQ but have not yet answered questions regarding the impact it can have on disease transmission and infection. Questions epidemiological modeling could answer include the number of deaths prevented by widespread effective IAQ solutions, as well as the number of cases of flu and COVID-19 prevented, and subsequent savings for the economy and healthcare system.

- **Health Cost Modeling:** Private employers may be interested in understanding the potential ROI of IAQ investments, given the cost of adverse employee health outcomes due to reduced productivity and increased sick days. Additionally, ROI estimates could potentially factor into insurance plan offerings, such that providers could offer lower premiums to employers who invest in IAQ solutions.

Potential Steps: Potential funders should host conversations with key researchers to inventory past studies that sought to establish ROI proof-points and discuss novel ways to expand this area of research to include additional real-world conditions.

Considerations and Assessment:

- **Long-Term Strategic Value:** While conducting studies to develop ROI Proof Points is clearly a valuable step towards widespread adoption, it does not propel medium and long-term strategic progress on its own. To guide stakeholders towards adopting IAQ solutions, the development of ROI Proof Points must be accompanied with interventions that reduce the prevalence of ineffective products. By releasing comparative studies on existing IAQ solutions and the information found through real-world testing of IAQ intervention technologies, along with developing ROI Proof Points, stakeholders should have the information they need to make decisions on implementing IAQ solutions into their spaces.

- **Real-World Impact:** As one expert explained, “people won't make improvements without either being forced to, or without a clear benefit, and the health of someone else isn't enough.” Developing ROI Proof Points would be a tangible way to address the cost/benefit research gap. Long-term, self-interest on the part of implementers is seen as one of the most important driving factors that will support and sustain adoption of IAQ solutions at scale. Outside of creating legal mandates or liability risks, which can require formal policy changes, demonstrating ROI will be key to creating that motivation.

- **Stakeholder Buy-In:** IAQ experts note that existing research in this regard is limited and that new efforts to quantify ROI will be important for achieving long-term field goals. Some government bodies considering large investments in IAQ technologies, such as transit agencies, are already pursuing limited effectiveness and ROI studies that could provide a set of interested stakeholders. Additionally, industry representatives and advocates may be particularly interested in studies that can show the value of their products and services.

- **Ease of Execution:** It may prove difficult to design and launch a study on the ROI of IAQ investments, particularly as it relates to infectious disease transmission. First, every indoor environment is unique, potentially requiring different ROI calculations and studies for different settings and use cases. Second, it can be difficult to quantify infectious disease transmission given that the installation of IAQ solutions in one environment cannot control for the air quality people are exposed to in other environments. For instance, a worker in an office building that installs HVAC upgrades may still contract the flu when they go to the store. Third, a study of ROI likely requires real-world experimental studies, which have potential moral considerations in study design and execution.

D.2 – Real-World Studies on IAQ Intervention Effectiveness

While solutions to improving IAQ are mostly well-known, significantly more research could be pursued to better understand exactly which solutions are most effective and under what conditions. Most testing has been conducted in controlled environments, but as experts note, every indoor environment is unique, and the real-world effectiveness of any given solution may prove different from that shown during testing. While researchers continue to develop a better understanding of best practices, including how to optimize use of different technologies and what technologies will be effective in different settings, real-world studies will provide an important input. Additionally, real-world studies will help researchers more accurately show the expected results of any particular IAQ investment, which will be important to developing impact and ROI estimates, and can act as strong levers for spurring adoption.

Evaluation Considerations

Criteria:	1-5 Score:	Reasoning:
Long-Term Strategic Value	4/5	A pre-requisite to establishing IAQ standards and ultimately regulations.
Real-World Impact	2/5	Unclear that this would massively change the IAQ industry.
Stakeholder Buy-In	3/5	Expected buy-in is high, except for potential pushback from industry.
Ease of Execution	2/5	Could be costly and time consuming.
"Now or Never" Factor	4/5	Likely to involve testing specifically for COVID-19.
Total:	**15/25**	**Rating: 60%**

Possible Approaches and Initial Steps:

- **Testing Proven Solutions in Different Contexts:** While it will be important to support testing of those IAQ solutions that are currently less proven, such as ionizers, real-world testing should be limited to those interventions that have already been shown to be safe. Real-world testing should focus on documenting differential effectiveness in various conditions and spaces, with a goal of learning how best to maximize impact.

- **Aligned Implementation Funding:** Efforts to support implementation of IAQ solutions with direct financing could incorporate a real-world study component, whether a pre-post design, or a quasi-experimental design.

Potential Steps: Potential funders could connect with leading IAQ researchers to understand interest in and approaches to pursuing real-world effectiveness studies. Interviews with key standard-setting organizations should also be pursued to better understand the IAQ intervention testing ecosystem.

Considerations and Assessment:

- **Long-Term Strategic Value:** Conducting real-world studies on IAQ intervention effectiveness is a necessary pre-requisite for establishing recommended standards for IAQ that could guide implementation and ultimately inform policymaking and the regulation of indoor air. It would also help to identify and elevate the most effective options, while helping to sift out less proven solutions.

- **Real-World Impact:** Real-world effectiveness studies are an important missing tool that can help stakeholders make more informed decisions on IAQ intervention, while helping to document the benefits that can be achieved from different types of interventions. This knowledge base could help prevent adverse consequences from unproven IAQ solutions that have the potential to be harmful. That said, outside of the long-term role such studies would play in advancing policy and standard setting, it is unclear if this research alone would do much to increase adoption rates in the near- or medium-term, particularly given that most IAQ solutions are generally understood to be effective.

- **Stakeholder Buy-In:** The lack of real-world studies on IAQ intervention effectiveness is regarded as a top priority by many experts in the field, so there would be a high level of buy-in for pursuing such work. For instance, one field stakeholder has already been awarded grant money to begin work on randomized controlled trials, but noted they would need additional funding to complete the studies. Alternatively, an independent consortium, composed of stakeholders in the research branch, could be created to work together on addressing this research gap. However, there may be some pushback from industry representatives. This intervention also lends itself well to the COVID-19 moment as good IAQ is currently relevant for stakeholders and the general public.

- **Ease of Execution:** While testing IAQ intervention effectiveness in real-world environments is a clear need expressed by stakeholders, executing such research could be costly and time consuming. Additionally, if the testing is occurring in operating real-world environments, there is the potential for ethical complications, especially in spaces where real-world IAQ intervention effectiveness data is most needed, such as schools, public housing, and other high-risk settings. Because of this, gaining NIH approval for real-world studies could prove difficult.

D.3 – Developing Recommended IAQ Standards

While key organizations and government agencies such as the EPA and the Department of Energy have published some IAQ standards and recommendations for the public, experts in the field have mentioned the lack of healthy air standards as it directly relates to disease transmission. Presently, there are no guidelines on standard air exchanges per hour, standard scientific ways to measure IAQ, ideal combinations between energy efficiency and safe IAQ, or what level of virus in the air is deemed to be dangerous. Before efforts can advance to promote policy and regulation, and before individual actors can most effectively improve IAQ in their buildings, consensus standards and recommendations for IAQ need to be developed.

Evaluation Considerations

Criteria:	1-5 Score:	Reasoning:
Long-Term Strategic Value	4/5	Standards are necessary pre-requisites to IAQ-specific regulation and policy.
Real-World Impact	3/5	While standards would create the necessary conditions, it is unclear that they would directly produce massive change.
Stakeholder Buy-In	3/5	Despite potential concerns about competing standards, most stakeholders are eager to establish cooperative standards.
Ease of Execution	3/5	Variations in specific settings and persistent research gaps may complicate an otherwise straightforward intervention.
"Now or Never" Factor	4/5	While the current moment provides incentive to work on these standards, they would also be useful outside of the COVID-19 context.
Total:	**17/25**	**Rating: 68%**

Possible Approaches and Initial Steps:

- **Standard Setting Working Group:** Multiple stakeholders have noted the value of developing a working group of IAQ experts and cross-sector stakeholders charged with developing IAQ standards, including an infectious disease component. Such a working group could be convened by existing standard setting bodies, such as relevant non-profit organizations or government agencies, or could be launched by the NIH, NAS, or other research consortiums. Each of these could be made possible with philanthropic support and buy-in.

- **Collaboration with Federal Stakeholders:** An important component of researching and designing IAQ standards for disease transmission is designing them in a way that best lends itself to being implemented as policy. It is possible that this could take the form of a working group convened by a federal agency, such as the EPA, or it could involve ensuring government policymakers are included in any externally led process.

Potential Steps: Potential funders should speak with leading experts to better understand current standards and processes for development and identify potential partners and conveners interested in advancing a more formalized cross-sector standard-setting process. Conversations with existing regulatory agencies should also be pursued.

Considerations and Assessment:

- **Long-Term Strategic Value:** Over the longer-term, the establishment of IAQ standards are a necessary prerequisite to establishing policy and regulation over IAQ. Establishing consensus standards would also arm individual actors with stronger guidance on IAQ intervention goals and practices and could hold more weight than existing guidance.

- **Real-World Impact:** While the creation of consensus IAQ standards would help focus industry and government and give a basis for stakeholders to understand the relative safety of their specific settings, it is unclear if this would create large changes in real-world adoption without standards being turned into policy.

- **Stakeholder Buy-In:** Many stakeholders have noted interest in additional work to develop consensus IAQ standards. Potential challenges could arise if new standards compete with existing efforts to develop standards and guidance, however field stakeholders generally note aligned interest even among standards-setting bodies in advancing such work.

- **Ease of Execution:** Convening experts to develop IAQ standards may be simple on the surface, but such work could prove difficult given relevant research gaps. Various methodologies have been proposed for establishing recommended air changes per hour and safe IAQ levels, but more research is needed in this regard, and in some cases, the safety of a building's air may be extremely case-dependent. Similarly, the research on airborne disease transmission and the effectiveness of particular IAQ solutions in reducing infection risk is still developing.

D.4 – Industry-Wide Testing Standards

At present, the IAQ intervention landscape has been compared to the "wild west" by stakeholders and experts in the field, given limited regulation. Ventilation, filtration, and some UV solutions are understood to be proven and safe. However, the lack of regulations, standards, and oversight has allowed a series of newer and potentially harmful products to enter the market with claims of proven effectiveness, despite concerns in the scientific community over the safety of these products or the validity of current testing practices. For instance, some products are tested in chambers the size of shoeboxes, bearing little resemblance to real-world environments, and designed for the success of each product. Testing practices also vary widely between products and companies, making it difficult to understand how to compare across product lines or what products to trust. Additionally, there are no standards for products themselves.

Evaluation Considerations

Criteria:	1-5 Score:	Reasoning:
Long-Term Strategic Value	4/5	Industry-wide testing standards would help IAQ intervention credibility immensely.
Real-World Impact	3/5	These standards could have a large impact on the industry but would not directly improve IAQ.
Stakeholder Buy-In	2/5	A lack of industry buy-in, despite the need, may make this intervention difficult.
Ease of Execution	2/5	The lack of incentive structure for industry means that would be difficult to execute this intervention.
"Now or Never" Factor	4/5	The high demand for IAQ solutions due to COVID-19 makes this solution more valuable.
Total:	**15/25**	**Rating: 60%**

Possible Approaches and Initial Steps:

- **Development of Universal Testing Standards:** The development of industry-wide standards would help establish effective technologies that meet baseline requirements and systematize the testing processes, which would therefore diminish the current risks posed by less-proven products.

Potential Steps: Potential funders should speak with industry experts and researchers, both to better understand the research needs to develop testing standards and the willingness of individual companies to accept or adhere to such practices.

Considerations and Assessment:

- **Long-Term Strategic Value:** Industry-wide testing standards could lay the foundation for eventual policy and regulation over the IAQ marketplace, which would be an important component of a more effective IAQ ecosystem.

- **Real-World Impact:** Establishing agreed-upon, industrywide testing standards could be an important lever for helping to sift out bad products from the market and ensure that consumers pursuing IAQ solutions are purchasing safe and effective products. However, this may not have much direct impact on the adoption of IAQ solutions writ large.

- **Stakeholder Buy-In:** While NIOSH does create certain standards for masks and filters, without more widespread buy-in from the major industrial players that are responsible for many of the portable air filters and other interventions, it is unlikely that a singular standard will be agreed to.

Thus, any movement toward an agreed-upon standard would have to incorporate input from industry as a prerequisite to any kind of establishment of standards. It is possible, however, that some industry actors promoting more proven solutions, or those with other competitive advantages over other actors, may be in favor of testing standards that could better elevate their own products.

- **Ease of Execution:** Developing standards for testing is unlikely to be difficult in its own right, but having those standards adhered to could prove difficult without industry engagement or formal policy.

D.5 – Research to Support Development of IAQ Technologies

While the IAQ technological landscape is more well-defined than other areas of the ecosystem, there are still gaps that need to be addressed. This intervention mainly includes options that work to translate the research on effective technologies into safe, effective products for consumers. Some examples of this intervention put into practice include, but are not limited to: funding studies on safe and effective UV cleaning products, developing better design for UV lights, or funding research on viral monitoring and rapid identification devices.

Evaluation Considerations

Criteria:	1-5 Score:	Reasoning:
Long-Term Strategic Value	4/5	Enabling new interventions through research has strong long-term strategic value.
Real-World Impact	3/5	If successful, new technological development could have massive impacts on the IAQ space.
Stakeholder Buy-In	4/5	Funding research in key areas to be used for IAQ purposes is unlikely to meet significant opposition.
Ease of Execution	2/5	We cannot predict if R&D will be successful, making successful impact difficult to anticipate.
"Now or Never" Factor	3/5	The COVID-19 pandemic continues to be a major point of interest in the space.
Total:	**16/25**	**Rating: 64%**

Possible Approaches and Initial Steps:

- **Fund Development of Potentially Breakthrough IAQ Technologies:** If successful, developing these technologies from proofs of concepts to deployable interventions could create transformative change for the IAQ industry, and lead to more effective deployment of IAQ solutions where impact can be maximized.

Potential Steps: Potential funders could speak with industry and research stakeholders to inventory the current state of cutting-edge IAQ research and better define potential investment opportunities in specific research programs or pilots.

Considerations and Assessment:

- **Long-Term Value:** Further investment in technology development could help improve safety and lower costs of current options (such as some UV technologies) while also offering opportunities to augment traditional solutions and improve impacts (such as with development of IAQ monitoring technologies). Monitoring technologies could play an important role in helping to optimize IAQ solutions and the operation of IAQ systems in ways that could improve effectiveness, reduce energy costs, and more, factors that one interviewee said could prove to be a "game changer."

- **Real-World Impact:** Technology development is likely a long-term play, but could help improve the safety, effectiveness, and cost of products on the market of different solutions. However, the current gap in adoption is not due to a lack of technology solutions, so the development of more technologies without also addressing the gap in public awareness would not lead to increases in adoption.

- **Stakeholder Buy-In:** Field stakeholders agree that additional technology development could be beneficial, though it is not the most pressing need. UV technology was noted as an increasing

area of focus for researchers. One researcher brought attention to a recent study on using drop-ceilings to deploy uncontained UV lights in a contained manner.

- **Ease of Execution:** Technology development could prove costly, with a long path until impact is realized. Additionally, it is unclear what ready opportunities exist to invest in technology development. That said, UV technology has recently garnered significant interest among academic researchers, possibly offering a path toward university-based research efforts on targeted solutions.

E: Reference Figures